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# Smartphone-Based Automated Diagnosis of Otitis Media: A Neural Network Approach

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## Abstract

Otitis media is a prevalent childhood illness, particularly in resource-constrained regions where access to ear specialists and specialist equipment is limited. This paper presents an extended system for automated diagnosis of middle ear pathology, specifically otitis media, that can be used on a smartphone with an internet connection. The system incorporates a neural network as a classifier and compares its performance to a previously proposed decision tree. It achieves high accuracy in diagnosing various middle ear conditions, including normal tympanic membrane, obstructing wax or foreign bodies, acute otitis media (AOM), otitis media with effusion (OME), and chronic suppurative otitis media (CSOM). The average classification accuracy of the proposed system is 81.58% (decision tree) and 86.84% (neural network) when using commercial video-otoscopes. The system utilizes 80% of the 389 images for training and 20% for testing and validation.

**Keywords**: Otitis media, middle ear pathology, smartphone diagnosis, image analysis, neural network.

## I. Introduction

Otitis media, commonly known as middle-ear infection, is one of the most prevalent childhood illnesses worldwide. It encompasses conditions such as acute otitis media (AOM), otitis media with effusion (OME), and chronic suppurative otitis media (CSOM). CSOM, often resulting from recurrent AOM, is a leading cause of acquired hearing impairment in children. However, in many developing countries, access to ear specialists and specialist equipment is rudimentary, making accurate diagnosis challenging. General practitioners may lack experience in differentiating between different forms of otitis media, further complicating the situation[1-2].

To address these challenges, an automated diagnosis system for middle ear pathology, specifically otitis media, has been proposed. This paper extends the previous system to enable its usage on a smartphone with an internet connection. Leveraging the widespread availability of smartphones, particularly in developing countries, the system aims to improve access to otitis media diagnosis and reduce dependence on specialized equipment and personnel [3]. The extended system incorporates a neural network as a classifier, replacing the previously proposed decision tree. The neural network's performance is compared to that of the decision tree to assess its diagnostic capabilities. The system achieves high accuracy in classifying different middle ear conditions, including normal tympanic membrane, obstructing wax or foreign bodies, AOM, OME, and CSOM [4-5].

The proposed system utilizes commercial video-otoscopes to capture tympanic membrane images. It employs image processing techniques and feature extraction algorithms to extract relevant visual features, which are then classified using the decision tree or neural network. The training and validation of the system utilize 80% of the available images, while the remaining 20% are used for testing. The average classification accuracy of the system is reported as 81.58% for the decision tree and 86.84% for the neural network [6]. By extending the system to run on a smartphone with an internet connection, the proposed approach offers the potential for improved accessibility and cost-effectiveness in diagnosing otitis media. This has significant implications, particularly for underserved communities and developing countries where access to specialized healthcare services is limited. By leveraging the smartphone revolution and the growing availability of internet connectivity, this system aims to empower healthcare providers

with a smartphone-based image capture solution, future developments aim to include a cost-effective extension. This extension would allow the smartphone to capture high-quality tympanic membrane images using either the built-in camera or an external low-cost custom-made USB otoscope. Subsequently, the proposed system could be applied to diagnose otitis media based on these captured images, representing a comprehensive and accessible solution for automated otitis media diagnosis.

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