

# Design Flow for AI-driven Medical Systems Demonstrated through an Example in Dental Imaging Analysis

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## I. INTRODUCTION

The use of Machine Learning (ML) mechanisms for image analysis in dentistry may potentially bring many benefits. At the same time, potential challenges may include the availability of dental images, the availability of specialist imaging equipment, and the selection of an appropriate ML model. The main goal of this paper is to propose a procedure for designing an ML-based module of a dental system for analyzing dental images, using the example of a tooth detection algorithm within images obtained from popular devices such as a camera or a smartphone. As part of this paper, a review of open access dental image datasets with assumed characteristics was conducted, followed by a review of ML models used for tooth detection. Next, a proposal for the architecture of a tooth detection module was developed along with a prototype implementation version. The works carried out also constituted an extension of the DentIO system, enabling, among other things, the generation of dental diagrams based on voice commands.

In this paper a fragment (presented in Fig.1) of the system that supports dental practice is analyzed using the automatic analysis mechanism of dental images for tooth detection, its efficiency, complexity and potential availability for dentists and patients. In particular, in terms of the availability of the algorithm, one of the assumptions made is to limit the input data only to images from relatively common devices, such as a camera or a smartphone. Such an approach might potentially increase the range of recipients due to the lack of the need to use specialist dental imaging equipment, however, on the other hand, it might leave the question of the potential algorithmic efficiency. An additional challenge associated with this approach might be the availability of public dental image datasets with such characteristics on the basis of which AI models could be trained. In the longer term, beyond the scope of the current article, the suggested algorithm could be one of the elements of the method developed to support the diagnosis of Temporomandibular Joint Disorder (TMD). The suggested tooth detection mechanism might potentially be used in the

analysis of jaw movement tracking based on the recorded video image.

The following research questions are addressed in this paper.

- RQ1 What publicly available dental image collections containing camera images could be found in the literature?  
RQ2 What classes of algorithms have been suggested in the literature for tooth detection from dental images?

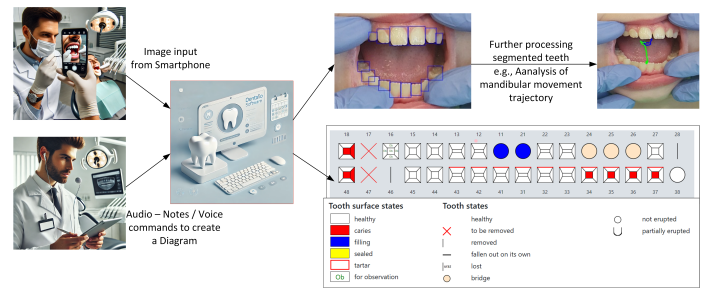


Fig. 1. Example Functionality of the DentIO System

## II. CONCLUSIONS

As an example of ML models used for image tooth detection, we have discussed an AI tool that would help segment (recognized) teeth from images. The YOLO model was chosen for this application. We have presented the parameters obtained from the trained model. As an example, the practical application of the presented solutions, DentIO, a system that supports dental work, was briefly described. The elaborated module was used successfully for teeth segmentation. This result is an initial point for other algorithms that can be used to improve dental diagnosis, e.g., analysis of mandibular movement trajectory. The elaborated DentIO system is currently under preliminary tests in the dental clinic of the Poznan University of Medical Science.

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