# Software Tools for Supporting Automatic Interpretation of Medical Images

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***Abstract*— In the domain of medical imaging, the role of automated image interpretation tools is becoming increasingly critical in facilitating the diagnosis and treatment of diverse diseases. The escalating volume and intricacy of medical images necessitate the development of advanced tools that can support automatic image analysis. This paper outlines on-going work associated with the design and implementation of extensions and plugins for widely used DICOM viewers, specifically Weasis, Dicoogle, and Orthanc. The primary objective is to augment the functionality of these viewers, empowering them to assist radiologists and healthcare professionals in the comprehensive interpretation and analysis of medical images. This abstract outlines how DICOM viewer extensions and plugins can be integrated with machine learning models to enhance the efficiency and accuracy of medical image interpretation, ultimately leading to improved patient care and outcomes.**

***Keywords—DICOM, radiologist, interoperability, annotation***

## I. Introduction

The field of medical imaging has witnessed remarkable advancements, leading to the availability of high-resolution images that play a crucial role in precise diagnosis and effective treatment planning. Despite these technological strides, the interpretation of medical images continues to pose challenges, relying heavily on the expertise and experience of radiologists and healthcare professionals. To alleviate their workload and enhance efficiency, there arises a demand for tools that can automate certain aspects of image interpretation. In light of this, the present paper delves into the exploration, design, and development of extensions or plugins tailored for DICOM viewers, specifically focusing on Weasis, Dicoogle, and Orthanc. The primary objective is to augment the functionality of these viewers, empowering them to provide automated support for the interpretation of medical images. By integrating advanced algorithms and techniques, these extensions aim to streamline and optimize the image interpretation process. They hold the potential to assist radiologists by automatically analyzing and extracting relevant information from medical images, aiding in the identification of abnormalities, and generating valuable insights to guide clinical decision-making. The research presented in this paper encompasses the development of innovative plugins for the DICOM viewers, which incorporate state-of-the-art methodologies such as deep learning, computer vision, and pattern recognition [1]. By harnessing the power of these enhanced viewers, healthcare professionals can benefit from reduced interpretation time, increased accuracy, and improved workflow efficiency, ultimately leading to enhanced patient care and treatment outcomes.

## II. Related work

### A. Challenges with Medical Interpretation

Medical image interpretation presents significant challenges due to the increasing volume and complexity of imaging data. One of such challenges is expertise and experience dependency [2]. Achieving accurate and reliable interpretation of medical images heavily relies on the expertise and experience of radiologists and healthcare professionals. The human visual system is intricate, and understanding the intricacies of medical images requires specialized knowledge and extensive training. Different practitioners may have varying levels of expertise and experience, which can lead to potential variations in diagnosis and treatment planning .

Manual interpretation of medical images is time-consuming, leading to potential delays in diagnosis and treatment initiation, especially in time-sensitive cases [3]. The increasing volume of medical imaging data, including multiple modalities such as X-rays, MRIs, CT scans, and ultrasound, presents a significant challenge for radiologists and healthcare professionals. Reviewing and analyzing a large number of images for each patient requires substantial time and effort, which can result in delays in providing timely diagnosis and treatment recommendations.

Medical imaging technologies have evolved to produce a vast amount of imaging data, including X-rays, MRIs, CT scans, and ultrasounds. The exponential growth in imaging studies, combined with the increasing complexity of medical cases, can overwhelm radiologists and lead to cognitive overload. This overload can result in fatigue, reduced attention, and potentially increase the risk of errors in diagnosis.

### B. Software Interventions

Innovative solutions are actively being explored by researchers to address some of the challenges with medical

image interpretation. One approach is the development and integration of computer-aided detection (CAD) systems and artificial intelligence (AI) algorithms. CAD systems utilize advanced algorithms to automatically analyze medical images, flag potential abnormalities, and provide decision support to healthcare professionals. These systems can help expedite the interpretation process by pre-screening images and highlighting areas of interest that require further attention. By reducing the time spent on manual review, CAD systems enhance the overall efficiency of image interpretation [4].

Furthermore, AI algorithms, particularly deep learning models, have shown promising results in automating aspects of medical image analysis. These algorithms can learn from vast amounts of annotated data to recognize patterns, detect anomalies, and aid in diagnosis. By leveraging AI-driven approaches, healthcare professionals can potentially expedite the interpretation process and make more accurate assessments [5].

Efforts are also underway to improve image acquisition and processing techniques, aiming to streamline the overall workflow and reduce the time required for interpretation. Advancements in imaging technologies, such as faster scanning protocols and real-time image reconstruction, contribute to more efficient data acquisition. Additionally, cloud-based image storage and remote access solutions enable radiologists to access and interpret images from various locations, improving accessibility and reducing time constraints [6].

## III. Methods

Automatic image interpretation systems are software programs that can be used to analyze medical images and to identify potential problems. Weasis, Dicoogle and Orthanc can be integrated with automatic image interpretation systems to provide radiologists with real-time feedback on their diagnoses. This could help radiologists to make more accurate diagnoses and to identify potential problems sooner.

There are several approaches available for integrating these platforms with automatic image interpretation systems to enhance their capabilities. One such approach under active development involves the utilization of a plugin that enables seamless communication between the DICOM viewer and the automatic image interpretation system. Through this plugin, the DICOM viewer can effortlessly transmit medical images to the automatic image interpretation system for analysis and subsequently receive the results of the analysis. This integration facilitates a streamlined workflow, allowing for efficient collaboration between the viewer and the interpretation system.

Another method for integrating DICOM viewers with automatic image interpretation systems entails leveraging a web service. In this scenario, the automatic image interpretation system exposes a web service interface, enabling the DICOM viewer to transmit medical images to the interpretation system for analysis. Through this web service, the viewer can securely send images to the system and retrieve the corresponding analysis results. This approach provides flexibility and compatibility, as the DICOM viewer can interact with the interpretation system via standard web protocols, facilitating seamless data exchange and fostering interoperability.

Both the plugin-based integration and the utilization of web services offer distinct advantages in integrating DICOM viewers with automatic image interpretation systems. The choice of approach depends on factors such as system architecture, compatibility requirements, and the specific capabilities of the viewers and interpretation systems. Regardless of the chosen integration method, the ultimate goal is to create a cohesive environment where medical images can be effortlessly transmitted, analyzed, and interpreted, thereby enhancing the efficiency and effectiveness of image interpretation in the medical field.

## IV. Benefits

The integration of Weasis, Dicoogle and Orthanc with automatic image interpretation systems could have a number of benefits for radiologists. First, it could help radiologists to make more accurate diagnoses [7]. By providing radiologists with real-time feedback on their diagnoses, automatic image interpretation systems could help radiologists to identify potential problems sooner. This could lead to earlier treatment and better outcomes for patients.

Secondly, it could help radiologists to be more efficient. By automating some of the tasks involved in image interpretation, automatic image interpretation systems could free up radiologists' time so that they can focus on other tasks, such as patient care.

Thirdly, the integration of the platforms with automatic image interpretation systems could help to improve the quality of care. By providing radiologists with access to more information, automatic image interpretation systems could help radiologists to make more informed decisions about treatment. This could lead to better outcomes for patients.

The integration is still in its early stages. However, there is a lot of potential for this integration to improve the quality of care for patients. As the technology continues to develop, we can expect to see more and more integration between DICOM viewers and automatic image interpretation systems.

## V. Implementation

As a starting point, work is currently being done to implement a plugin for annotation of medical images in the Weasis viewer. The plugin is meant to work hand in hand with an AI model that will be aiding in automatic interpretation of Dicom images. This section provides a detailed explanation of the implementation process and the interactions between the plugin, the AI model, and the Weasis viewer.

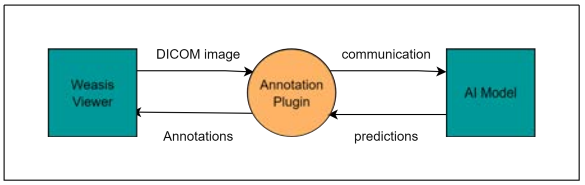

Fig. 1. Context diagram highlighting the interactions between the Dicom viewer, AI Model and Plugin.

### *A. Plugin Development*

The first step in the implementation process is the development of the plugin specifically designed for the Weasis viewer. The plugin acts as an intermediary between the viewer and the AI model, facilitating the automatic interpretation and annotation of medical images. The plugin is designed to capture the event of image loading within the Weasis viewer, enabling it to trigger the AI model for analysis and subsequent annotation. The development of the plugin for the Weasis viewer was inspired by the work of Rubin et al [8], who proposed the use of an electronic Physician Annotation Device for annotation and quantitative analysis of radiological images.

In the forthcoming context of Annotation Generation, the plugin will effectively utilize the annotation capabilities of the Weasis viewer to enhance the interpretation of medical images. By leveraging the output generated by the AI model, the plugin will dynamically generate annotations in real-time, allowing for the precise localization and characterization of identified pathologies. These annotations will serve as visual indicators, highlighting the affected areas within the loaded medical image.

By providing visual cues and relevant information about the nature and location of pathologies, the generated annotations will greatly assist radiologists and healthcare professionals in their interpretation and analysis of the medical image. This visual representation will enable a more comprehensive understanding of the image content, aiding in accurate diagnosis and treatment planning.

Fig. 2. Shows an example image with annotations in Weasis viewer [9].

The dynamic and real-time nature of the annotation generation process will ensure that the annotations are always synchronized with the AI model's output, providing up-to-date and relevant information. This seamless integration of AI-driven annotation generation within the plugin and the Weasis viewer will enhance the overall efficiency and effectiveness of medical image interpretation, ultimately benefiting both the medical professionals and the patients.

### *B. AI Model Integration*

The AI model emerges as a pivotal component in the realm of automatic DICOM image interpretation, exerting a profound influence on the overall process [5]. Leveraging the power of deep learning techniques, this AI model undergoes rigorous training on an extensive dataset comprising meticulously annotated medical images. This comprehensive training empowers the model to adeptly recognize and classify an array of pathologies with remarkable accuracy [10].

To seamlessly integrate the AI model into the plugin, a robust interface is established. This interface acts as a vital link, enabling smooth communication and efficient information exchange between the AI model and the plugin. Through this collaboration, the plugin gains access to the AI model's analytical capabilities, empowering it to automatically interpret and analyze images.

The integration of the AI model within the plugin architecture creates a mutually beneficial relationship. The plugin utilizes the AI model's advanced capabilities, while the AI model benefits from the plugin's interface to interact with the DICOM viewer and medical image data. This collaboration enables a comprehensive and automated approach to DICOM image interpretation, improving accuracy, speed, and efficiency.

By harnessing the AI model's deep learning capabilities, the plugin can effectively process and analyze DICOM images, extracting important information, detecting abnormalities, and generating valuable insights. This integration represents a significant advancement in medical image interpretation, with the potential to enhance diagnostic accuracy, streamline clinical workflows, and ultimately improve patient outcomes.

## VI. Conclusion and Future Work

In conclusion, the development and integration of extensions and plugins for DICOM viewers, such as Weasis, Dicoogle, and Orthanc, hold significant promise in advancing automated image interpretation in the field of medical imaging. By augmenting the functionality of these viewers with advanced algorithms and techniques, the efficiency and accuracy of medical image interpretation can be greatly enhanced. These tools have the potential to alleviate the workload of radiologists and healthcare professionals, automating certain aspects of image analysis and providing valuable insights for clinical decision-making. Future work in this field involves further refining and optimizing the integration of AI models with DICOM viewers, enhancing their performance and reliability.

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