

Automated Colonoscopy Polyp Detection

Abstract

Colorectal cancer is a leading cause of cancer-related deaths globally, and early detection of colorectal polyps during colonoscopy is critical for effective prevention and treatment. This paper presents the development of an innovative Django-based application designed to automate the detection of polyps in colonoscopy videos using advanced deep learning models. The primary goal of this application is to enhance the accuracy and efficiency of polyp detection, thereby supporting gastroenterologists in improving detection rates and patient outcomes.

The application integrates sophisticated video processing modules to handle and analyze colonoscopy footage. Utilizing the Django framework, the system processes video streams in real time, facilitating seamless integration into clinical workflows. The preprocessing stage involves enhancing the video quality, normalizing illumination, and segmenting frames to isolate relevant regions for detailed analysis. This preprocessing ensures that the data fed into the deep learning models is optimal for accurate polyp detection.

Central to the application are the deep learning models used for detecting and segmenting polyps. The system employs state-of-the-art Convolutional Neural Networks (CNNs), such as Mask R-CNN and YOLO, which are trained to recognize and delineate polyps from colonoscopy videos. These models are designed to provide precise segmentation and classification of polyps, distinguishing them from surrounding tissue and other artifacts. The integration of these models within the Django application enables real-time detection and alerts during colonoscopy procedures, allowing for immediate intervention when polyps are identified.

The application features an intuitive user interface that allows gastroenterologists to monitor and interact with the system during procedures. The interface displays real-time detection results, including highlighted areas where polyps are detected and classified. This real-time feedback is crucial for gastroenterologists to make informed decisions and ensure thorough examination of the colon. The interface also includes tools for reviewing and annotating detected polyps, facilitating subsequent analysis and reporting.

An essential aspect of the application is its ability to generate diagnostic reports based on the detected polyps. These reports include detailed information on the location, size, and characteristics of identified polyps, aiding in clinical documentation and follow-up planning. The reports are designed to integrate with existing electronic health records (EHR) systems, ensuring that polyp detection results are accessible and actionable within the broader context of patient care.

Data security and privacy are of paramount importance in the development of the application. The system implements robust encryption and access control measures to protect patient data and ensure compliance with relevant regulations, such as the Health Insurance Portability and Accountability Act (HIPAA). This includes secure storage of video data and real-time encryption of data transmissions to safeguard patient confidentiality.

The application is designed with flexibility and scalability in mind, allowing for future enhancements and updates as advances in deep learning and video processing technologies occur. This adaptability ensures that the system remains effective in addressing emerging challenges in polyp detection and colorectal cancer prevention.

In conclusion, this paper details the development of a Django-based application for automated polyp detection in colonoscopy videos. By leveraging advanced deep learning models and integrating real-time video processing capabilities, the application provides a valuable tool for enhancing polyp detection rates and supporting gastroenterologists in clinical practice. The combination of real-time detection alerts, detailed diagnostic reporting, and secure data management highlights the application's potential to significantly improve the effectiveness of colorectal cancer screening and contribute to better patient outcomes.