

Public Abstract

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Title:WEB-BASED INTERACTIVE EDITING AND ANALYTICS FOR SUPERVISED SEGMENTATION OF BIOMEDICAL IMAGES

Biomedical imaging and image analysis is a vital source of information for quantitative studies in life sciences and improving healthcare medical diagnostics. Various imaging algorithms have been developed to extract essential features and information that assists in this process. One critical aspect is assessing the quality of automatic image and video analysis algorithms. The accuracy of automatic algorithms is usually evaluated against ground truth, which is determined by manual annotations provided by multiple experts at different locations, to develop robust object detection, segmentation and classification algorithms. Another aspect of manual annotations is supervised segmentation i.e. finding boundaries of regions associated with objects of interest in images and videos. Therefore, a tool that can support a host of complex annotation creation and editing operations in a collaborative manner with an easy to use web interface for cloud-based editing, analysis and storage is a key requirement for which there are few scalable solutions available. FireFly is a tool that was developed for manual and assisted expert annotation of images and videos for algorithm development and discovery. FireFly provides multiple domain experts at geographically different locations a collaborative tool for shared visualization and annotation that allows them to create, visualize and validate consensus ground truth and perform various image analysis tasks. FireFly is a web-based Rich Internet Application that is built on Adobe Flex, PHP and MySQL. In the context of big data, FireFly is used for managing large image collections, video sequences, collaborative ground truth generation, tracking and labeling for high-throughput studies and algorithm development. The primary objective of this project was to enhance FireFly's capabilities to allow interactive creation and editing of annotation objects like segments, contours and automatic back-end analysis of Biomedical images by interfacing with MATLAB executables. Efficient algorithms were developed for local cache management of large collections of image frames each with possibly hundreds of annotated objects that have complex geometry like polylines and polygons, along with their associated labels and related attributes. The FireFly user interface was significantly enhanced to provide greater functionality and ease of use for the non-specialist. FireFly has been used for several Biomedical applications in collaboration with NIH including malaria cell counting, wound healing cell assay analysis, detecting the boundaries of lung regions in patient chest x-ray images and tuberculosis disease classification for computer aided diagnosis. FireFly has also been used for the morphological analysis of vessel structure in capillaries and microvasculature of dura mater using epi-fluorescence microscopy images and for bacteria cell tracking.