Abstract

Image mosaicing is a data fusion technique used for increasing the field of view of an image. Deriving the mosaiced image entails integrating information from multiple images. Image mosaicing permits overcoming the limitations of a camera lens and help create a wide field of view image of a 3D scene and hence has a wide range of applications in various domains including medical imaging. This thesis concerns the task of mosaicing specific to neonatal retinal images for aiding the doctors in the diagnosis of Retinopathy of prematurity (ROP). ROP is a vascular disease that affects low birth-weight, premature, infants. The prognosis of ROP relies on information on the presence of abnormal vessel growth and fibrosis in periphery. Diagnosis is based on a series of images obtained from a camera (such as RetCam), to capture the complete retina. Typically, as many as 20 to 30 images are captured and examined for diagnosis. In this thesis, we present a solution for mosaicing the RetCam images so that a comprehensive and complete view of the entire retina can be obtained in a single image for ROP diagnosis. The task is challenging given that the quality of the images obtained is variable. Furthermore, the presence of large spatial shift across consecutive frames makes them virtually unordered. We propose a novel, hierarchical system for efficiently mosaicing an unordered set of RetCam images. It is a two-stage approach in which the input images are first partitioned into subsets and images in each sub-set are spatially aligned and combined to create intermediate results. Given n images, the number of registrations required to generate a mosaic by conventional approaches to mosaicing is $O(n^2)$ whereas it is $O(n)$ for the proposed system. These images are then again spatially aligned and combined to create a final mosaic. An alignment technique for low quality retinal images and a blending method for combining images based on vessel quality is also designed as part of this framework. Individual components of the system are evaluated and compared with other approaches. The overall system was also evaluated on a locally-sourced dataset consisting of neonatal retinal images of 10 infants with ROP. Quantitative results show that there is a substantial increase in the field of view and the vessel extent is also improved in the generated mosaics. The generated mosaics have been validated by the experts to provide sufficient information for the diagnosis of ROP.