CAD makes sustained progress

IMAGINE

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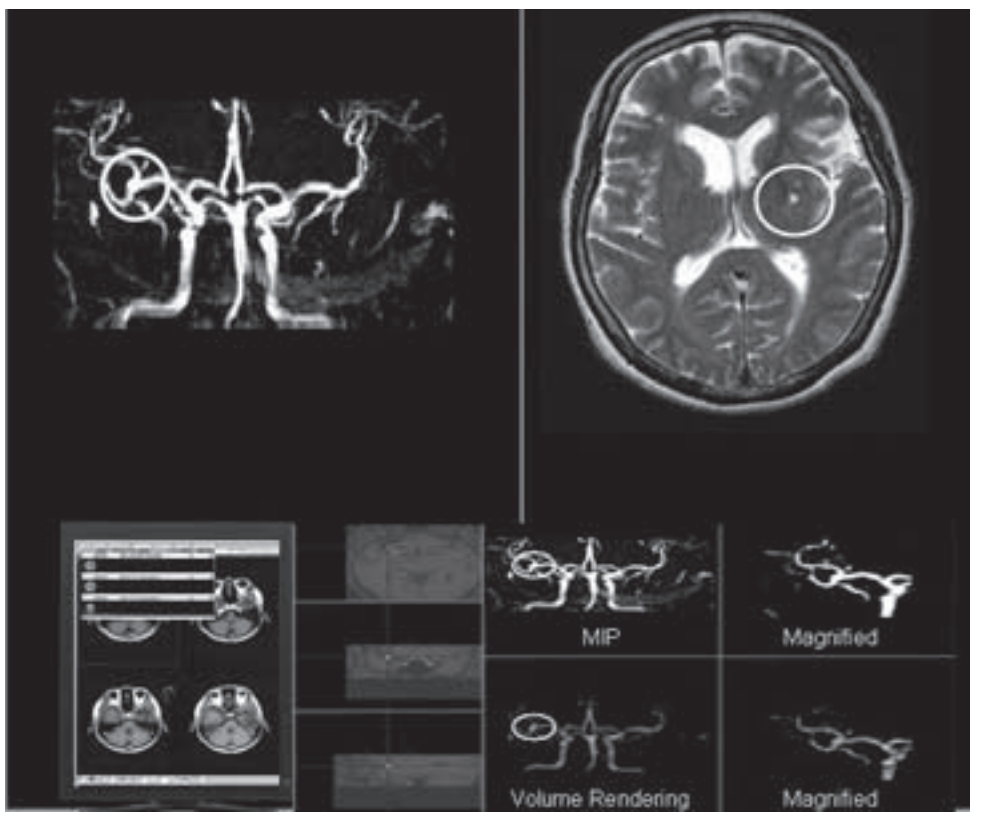
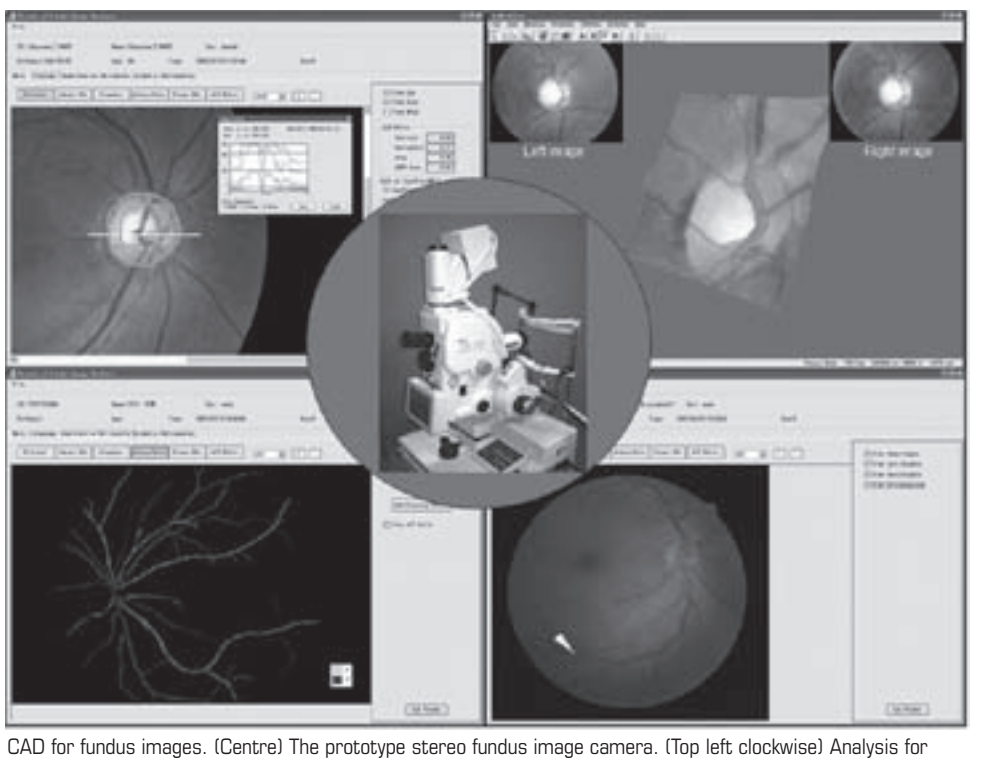
Currently, mammography is the standard technique for routine breast cancer screening for women aged 50 years or more. The technique is relatively simple, cost effective and has been shown to reduce mortality for up to 30-40%. However, for women aged 40-49, it is not clear if screening mammograms help in reducing breast cancer death. Inherent limitations of mammography limit the effectiveness of the modality in depicting masses in dense fibroglandular tissues. This is a problem not to be easily disregarded in Japan, as Japanese women tend to have dense breasts. In addition, the breast cancer incidence rate in Japan is highest among women aged 40-49. This motivated the interest of the Japanese healthcare authorities and industries in modalities other than mammography for breast healthcare in Japan.

Ultrasonography is widely used in medicine and is effective in imaging soft tissues of the body. The modality is based on the transmission and reflection of soundwaves rather than x-ray absorption in mammography, hence it does not have the same limitation of mammography towards dense breast tissues. Recent advances in ultrasound technology have pushed the boundary of breast ultrasonography. To date, breast ultrasound can provide excellent real time demonstrations of anatomic details in the breast. Its role has evolved from distinguishing fluid and solid masses, where the latter can be benign or malignant, to differentiating benign and malignant solid masses, a critical role in the diagnosis of breast cancer. Breast ultrasounds are typically performed by clinicians or ultrasonologists using a small (typically 4 cm) hand-held probe. Each examination takes about 20 minutes. Although breast ultrasonography is a valuable tool in breast cancer diagnosis, staff loading is high for screening purpose. In addition, results are operator-dependent and reproducibility is limited.

In addressing this issue, a prototype automated whole breast ultrasound scanner was specifically developed for breast cancer screening in Japan. The acquired three-dimensional volumetric whole-breast data can be constructed in a workstation which features a display of whole-breast ultrasound data in axial, coronal and sagittal views as well as flythrough mode, synchronisation of bilateral images, and computer-aided diagnosis (CAD) functions developed at the Department of Intelligent Image Information, Graduate School of Medicine, Gifu University. Other than the breast ultrasound CAD, included in this IMAGINE exhibit are two other CAD projects developed at the department as described in the following.



CAD systems for the detection of unruptured aneurysms (top left) and lacunar infarcts (top right). Viewing of the brain images (bottom left). Viewer features with CAD functions (bottom right).



CAD for fundus images. (Centre) The prototype stereo fundus image camera. (Top left clockwise) Analysis for glaucoma; Three-dimensional image of the optic nerve head generated from a stereo image pair; Detection of diabetic retinopathy (arrow); Recognising and identifying arteries and veins in a fundus image.

CAD for Brain MR

Cerebrovascular disease is one of the leading causes of death in developed countries. The prevention of this disease is of paramount importance. MRI and MRA are very useful for the early detection of cerebral and cerebrovascular diseases. In Japan, regular user-pay screening services for brain diseases are available. Such services typically include screening for lacunar infarcts, unruptured aneurysms and arterial occlusions. Clinical suites or facilities in hospitals that provide such screening services are commonly referred to as 'Brain Dock' in Japan (among other suites/facilities such as 'human dock', 'whole-body dock', 'heart dock', etc., which provide medical checkup for the body or the specific organ). The CAD system being developed at Gifu University uses MRI and MRA images to detect lacunar infarcts, unruptured aneurysms, and arterial occlusions. These medical conditions indicate an increased risk of severe cerebral and cerebrovascular diseases. The presence of lacunar infarcts increases the risk of serious cerebral infarction, and a ruptured aneurysm is the major cause of subarachnoid haemorrhage (SAH).

CAD for Fundus Images

Retinal fundus images are useful for the early detection of a number of ocular diseases that can lead to blindness if left untreated. In addition, the detection of diabetic retinopathy and hypertensive retinopathy in retinal fundus images during routine eye checkup can help the diagnosis of diabetes and hypertension, respectively, in the general public who are not already diagnosed with the diseases. Examinations using retinal fundus images are cost effective and are suitable for mass screening. CAD systems for detecting glaucoma, diabetic retinopathy, and hypertensive retinopathy using retinal fundus images are the focus in this project. A new digital stereo fundus camera has been specially developed for the incorporation of CAD systems. The stereo retinal fundus image pairs obtained using the new camera are used to generate depth maps of the optic nerve heads and 3D retinal fundus images in the workstation. The computer-generated depth map of the optic nerve head enables automated quantitative depth measurement of the optic nerve head in a retinal fundus and is important for the diagnosis of glaucoma.

The Department of Intelligent Image Information, Graduate School of Medicine, Gifu University, headed by Professor Hiroshi Fujita, is part of the Robotics Advanced Medical Cluster in Gifu-Ogaki, Japan, one of the eighteen cooperative research centers established across Japan since 2002 under the "Knowledge Cluster Initiative" of the Japanese Government, with the aim to promote industrial, academic and governmental cooperation in regional areas in Japan and to conduct innovative and technological research with a focus in advancing the Japanese technological industries.