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IBM and Mayo Clinic Medical Imaging Informatics Innovation Center

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The Medical Imaging Informatics Innovation Center (MI3C) is a collaborative research facility created by IBM Corporation and Mayo Clinic, and focuses on building awareness and interest in the field of medical imaging informatics. The Center highlights state-of-the-art imaging solutions and seeks to drive innovation in the field not only through its sponsors, but by third parties as well. The Center's research and development combines both parties' extensive experience in imaging and informatics, with the mission of bringing new benefits to patients, doctors, and administrators, while improving efficiency and lowering the cost of delivering medical care.

Collaboration by Design

The MI3C is an extension of an IBM and Mayo Clinic research collaboration announced in 2007. The facility is housed on the Mayo Clinic campus in Rochester, Minnesota, and brings together clinicians, researchers, and vendors in an interactive environment that fosters the free exchange of ideas and innovative thinking. The Center's collaborative efforts will explore projects related to medical imaging and radiology that hope to yield faster access to and better information for physicians, in addition to delivering improved diagnoses and treatments for patients.

The MI3C is the physical manifestation of the collective skills and knowledge possessed by IBM and Mayo Clinic. Both have made a long-term commitment to support the MI3C by staffing the center with researchers and other personnel in order to spur development in medical imaging informatics. By mutual agreement, third parties also will have the opportunity in the future to collaborate with IBM and Mayo Clinic in the facility.

The MI3C Mission

The MI3C will undertake research and development, as well as industry-awareness initiatives that seek to raise the profile of medical imaging technology and drive innovation in the burgeoning field of Imaging Informatics. As part of its initial activities, the Center will showcase existing imaging and informatics technology and solutions developed by IBM and the Mayo Clinic. However, a key goal is to garner interest from third parties, including medical instrumentation and device vendors, software developers, and other IT providers, in leveraging the Center as a resource toward their own development goals. The driving motivation behind the Center's work is to empower the healthcare community with advanced medical images and imaging resources that enable health care professionals to diagnose patient conditions more rapidly and in a less costly fashion.

Four Key Initial Research Themes

While there are numerous areas on which the Center will focus its energies, the MI3C has indentified four initial key research projects. These identified areas offer a balanced opportunity to achieve technological breakthroughs, while also providing immediate patient benefit and improved cost efficiency.

Image-Guided Tumor Ablation seeks to deliver pinpoint accuracy and maximum efficiency of the heat transfer probes that are commonly used to destroy cancerous tumors. With computer modeling of the heat transfer

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properties as well as the image-based tumor shape information, it is hoped that destruction of the tumor will be maximized while minimizing the impact on adjacent normal tissue.

Video Swallow Analysis seeks to assist in the treatment of stroke patients and others who have difficulty swallowing by analyzing images of patients as they swallow. This analysis assists medical personnel in recommending appropriate physical therapy based upon the patient's specific condition, as well as acting as a preventative measure against risk of disease caused by aspiration (food going into the lungs rather than the stomach).

Automated Change Detection and Analysis provides medical personnel with the ability to view an image that shows only the differences between comparative examinations. By understanding image properties, the computer can highlight regions likely to represent tumor progression or regression. Since the information involves more than one image type, it is substantially more powerful than simple image subtraction. Such analysis can not only improve diagnostic accuracy, but also can reduce the time necessary to assess images, thereby allowing the physician to focus on specifying treatment and patient care.

Automated Organ Identification and Measurement seeks to provide physical (phenotype) information that parallels the current level of genetic detail available for a given tissue sample. This is designed to give the attending physician a much more complete impression of a patient's condition than what current technologies can offer and could lead to new diagnostic and therapeutic techniques.

Technology, Intellectual Property, and Innovation

IBM and Mayo Clinic collectively bring unique, state-of-the-art intellectual property and resources to the Center. While each organization has a broad portfolio of expertise, there are specific items well suited to further the goals of the MI3C.

IBM's contribution includes hardware design and development expertise, as well as a history of extensive research and development into the fundamental algorithms that drive Medical Imaging Informatics. The Cell Broadband Engine, as well as the BladeCenter chassis, blades, and related technologies, will play a key role in the development of the MI3C's solutions. Further, IBM has a long history of working with Mayo Clinic. This mutual understanding of organizational structures and corporate lifestyle helps maximize effective working relations.

Mayo Clinic maintains a leadership position with respect to medical imaging research and informatics. As a result, it can contribute substantial expertise in refining and applying imaging algorithms in applications that ultimately support a working, real-life radiology environment. This combination of operational expertise with in-house, third-party algorithm development skill yields an ideal solution base that unites the research with practical, day-to-day application.

The MI3C also seeks to attract research grants for future investigations and research initiatives in order to extend its solutions beyond the initial four targeted research areas. Future research goals include growing a broad number of assets in imaging informatics, creating new graphics tools and physician support applications for visualization, and developing a comprehensive software library that supports all aspects of advanced medical imaging.

Potential Benefits and Looking to the Future

One of the key issues often facing medical personnel is the significant gap between the litany of patient and medical information available and the diagnosis at hand. There are patient records that are likely to exist in both electronic and written form and perhaps located in multiple repositories. In addition, there are in-house bulletins/updates on specific technologies/procedures, new scientific research published in professional journals and other media, and many potentially unknown sources from third parties. While at first blush one might suggest that simply having access to these data in electronic form would solve the problem, this does not address the real challenge. Even if all information were available in electronic form, this would merely serve to perpetuate information overload and does not distill data into actionable information to assist in or support a diagnosis.

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Integrated Information and Diagnosis

One area in which enhanced imaging and information management holds promise is in creating the electronic equivalent of the X-ray hanging on the light board. Most are familiar with the scene of a doctor hanging an X-Ray on a backlit wallboard to look for abnormalities or other clues to assist in a diagnosis. This is a slow process and is limited by human factors that influence the effectiveness and reliability of the diagnosis. If the image were digitally accessed within a known context of the patient's identity, the machine reading and assessment of the image could prove more rapid and accurate. Computers do not develop image-view fatigue and could support very high-resolution differential imaging. This is especially important when one considers that in 1980 radiologists would typically review 350 images a day, whereas today the number of images reviewed is likely to be upwards of 22,000.[1] By sheer numbers, the potential for an inaccurate reading is substantial. Hence, it is more important than ever that support systems for clinicians are able to distill relevant data into actionable information that is integrated into the diagnosis process.

Imaging and Cost Containment

The issue of cost containment is very important to the medical community. As the growth in medical expense continues unabated, service providers and insurance carriers are keenly searching for methods by which to streamline and improve patient care while also improving the cost efficiency of its delivery. The area of medical imaging is uniquely important in this respect as up to 17-20% of health related expenditures are now being driven by diagnostic images.[2] Some of the techniques being developed have demonstrated improvements in accuracy of diagnosis, as well as improvements in physician efficiency.[3]

Tele-radiology

While large metropolitan areas benefit from the expertise of highly focused caregivers in a variety of medical disciplines, this is often not the case in smaller population centers. The concept of "tele-radiology" seeks to bring the expertise of specialists to secondary markets and other remote locations without requiring the physical presence of said experts. The use of telepresence solutions such as video- or IP-based conferencing combined with digital imaging and digital health care records could provide medical professionals access to relevant patient data in a consultative patient engagement regardless of physical distance. Tele-radiology improves physician/specialist efficiency through a centralized diagnostic facility that enables patient access to specialist care while reducing per-patient cost. Since specialists can be leveraged across multiple health care providers without leaving their desks, this enables consultation with specialists that would otherwise not be physically or economically viable.

Summary

The Medical Imaging Informatics Innovation Center is an excellent illustration of the value of collaboration and pooling of research, development, and intellectual property. IBM and Mayo Clinic collectively bring a broad portfolio of expertise and resources to the Center. IBM brings a strong history in hardware design, software algorithm development, and extensive research and development capabilities, while Mayo contributes its leadership in medical imaging research, informatics, and experience in real-life radiology environments. Both parties are seeking to leverage their considerable experience in imaging informatics to drive innovation in this field. The Center's innovative research and development into medical imaging informatics has the potential to bring new benefits to patients, doctors, and administrators alike, while improving operating efficiency and lowering the cost of delivering medical care.

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[1] Andriole KP, Morin, RL, Arenson RL, et al. "Addressing the coming radiology crisis–the Society for Computer Applications in Radiology transforming the radiological interpretation process (TRIP) initiative. J Digit Imaging, Dec 2004. 17(4) 235-43

[2] Imaging Economics Magazine, "Imaging Trends: A Forecast for 2005-2007."

[3] Erickson BJ, Mandrekar J, Wang L, et al. "Effect of automated image registration on radiologist interpretation." J Digit Imaging Jun 2007, 20(2) 105-13

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