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The Intelligent Medical Imaging System: The Use of Cloud Technology and Computer-aided Methods

Fuk Hay Tang
Charles Sturt University, Boorooma Street, Wagga Wagga NSW 2678, Australia

Introduction

The rapid development of high-speed networks and smart mobile devices has transformed the health care services to next generation for the efficient delivery of data and information services. The integration of Picture Archiving and Communication System (PACS)with cloud computing technology has remodeled patient management practices. Certainly, the wide coverage of smart mobile device apps, Gigabit Ethernet networks, and 4G wireless mobile communications technology are the key drivers for the improvements.

Web-based Model for ImageDelivery

The PACS architecture model can be divided into stand-alone models, client-server model and/or Web-based model.

In the scenario of stand-alone model, PACS workstations have high computing power to provide local storage, image processing and reconstruction. The operation of the workstation is independent of network connectivity. In the thin client model, client computers need to connect to the centralized server through a network to provide image delivery and process services. Client computers have limited computing power and local storage. Most Web-based computers, smart phones, and handheld tablet computer can access PACS to perform similar tasks as PACS workstations. Thin client computers usually do not need local installation of PACS application software. Instead, the PACS client services are accessed through the Web browsers.

Cloud Technology

Cloud computing technology offers an on-demand access to shared pool of resource through network with minimal efforts from users [1]. Conventionally, IT is very important to support PACS operation. It requires database management and daily QA operation of image transmission. With cloud computing, IT support and image database become concentrated with shared data among hospitals and imaging centers. By using cloud technology, the client PACS are installed on demand service through the networks.

Smart PACS Initiatives

PACS with its capacity as a digital image management and storage system, it renders a rich resource for knowledge discovery in digital image data contained in the image. Computer-aided detection and diagnosis (CAD), on the other hand, utilises mathematical algorithm to provide quantitative data to help clinical decision and serves as a second opinion to clinicians. CAD is usually worked in a separate workstation. In order to facilitate the efficient detection of abnormal signs in images, CAD servers can be combined with PACS [2]. There is no doubt that CAD integration in PACS workflow will simplify CAD output with direct viewing in PACS workstation. The use of PACS image database would provide a more accurate and effective diagnosis process. Huang [3] suggested CAD-PACS toolkit to integrate PACS with CAD. It follows that a smart PACS scenario where PACS has built-in intelligence by PACS--CAD integration can be deployed in a cloud environment.

It is noted that in the DICOM format of medical images, the DICOM header information (such as examination type, radiation dose recorded) canbe extracted for data mining. This helps knowledge discovery in a PACS System and the PACS becomes "smart".

Conclusion

The new development of Web technology with thin clients and smart mobile devices has reformed the deployment of traditional PACS. PACS service is no longer limited to the workplace, but is available nearly everywhere. Furthermore, the use of PACS is not just restricted to image distribution and management system, but a means to generate knowledge and support clinical judgment. However, the centralized trend of PACS poses the concerns for data security and patient privacy. With the concept of "Big Data" and data mining, the behaviours of clinicians, patients and related users can be tracked with a click of button. This should be considered seriously for the design of smart PACS initiatives.

Competing Interests

The authors have no competing interests with the work presented in this manuscript.

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***Corresponding Author:** Prof. Fuk Hay Tang, Charles Sturt University, Boorooma Street, Wagga Wagga NSW 2678, Australia; E-mail: haytang@gmail.com

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