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Spark Med: A Framework for Multimedia Medical Data Integration of Adaptive Mobile Object in Heterogeneous Systems

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***Abstract:** Spark Med is Self-managing, Pervasive Automated netwoRK for Medical Enterprise Data (SparkMed). It is a framework for mobile healthcare which is obtained from the improved network wireless technologies. It allows a wide range of heterogeneous medical software and database system to be dynamically incorporated in to peer to peer multimedia data. SparkMed incorporates techniques from multimedia streaming, rich Internet applications (RIA), and remote procedure call (RPC) .This framework allows medical data applications to share data among mobile host over wireless.'*

***Keywords:**RPC,RIA,HL7;Automatedsystems;biomedicalengineeri ; handheld computing; m-Health; middleware*

I. INTRODUCTION

Modern information technology is being increasingly used in the healthcare sector with the sole objective of enhancing the availability of improved medical services at reduced costs. The next generation of networking is the 4G and long-term evolution (LTE) wireless technologies such as iMAX, which are all IP-based heterogeneous networks designed to greatly expand the accessibility and usability of any internet-connected system. LTE technologies are portable, lightweight and nonproprietary, and provide mobile devices with access to integrated communications standards that have low transmission costs and rich multimedia support. A major goal of LTE wireless technologies is the reliable wireless data services that can allow even simple handheld devices to easily make use of multiple multimedia data streams at the same time.

Use of LTE in mobile healthcare technology involves major costs in money, time, and computing resources for any hospital infrastructure ,and difficult to change and using new systems. The most important problems, in using medical health data are the limited scope of access to data in hospital infrastructure systems, the need to replace medical applications and data services until it support a networked healthcare model, the storage requirements to keep medical data from becoming portable and the lack of a centralized storehouse. SparkMed incorporates techniques such as rich Internet applications (RIA), and remote procedure call (RPC) , Rich Internet Applications (RIAs) are an emerging software platform that blurs the line between web service and native application, and is a powerful tool for handheld device deployment.

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By democratizing health data management and widening its availability, this software platform has the potential to revolutionize telemedicine, clinical practice, medical education and information distribution, particularly in rural areas, and to make patient-centric medical computing a reality.

SparkMed design ensures minor interference with the regular operation of the host medical software, minimal transparency to make sure that the host system's performance remains unaffected while used across any IP-based connection and limit the cost and scope of reprogramming. SparkMed provides a number of automated, self-configuring services such as data monitoring and synchronization, thread pooling for remote functions, collaborative remote control capability, and transcoding to web-based standards.The SparkMed application networks itself automatically and the required data items are then automatically synchronized by the SparkMed framework: the remote user is immediately delivered the same database data, metadata, imagery, and variables in use on the initiator's machine (or machines), at which point he/she is able to manipulate each connected system directly, with results visible immediately to both parties. Figure 1 shows the outline of the network. This network is composed of devices inside and outside of hospitals and medical institutions both desktop and mobile and a series of web servers that can be either intranet based or internet based. First our network architecture is automatically self-generated without the need for user input or even network support in the host application. Second the daemon technique is used to run a transparent, attached process thus allowing compatibility with legacy medical software.

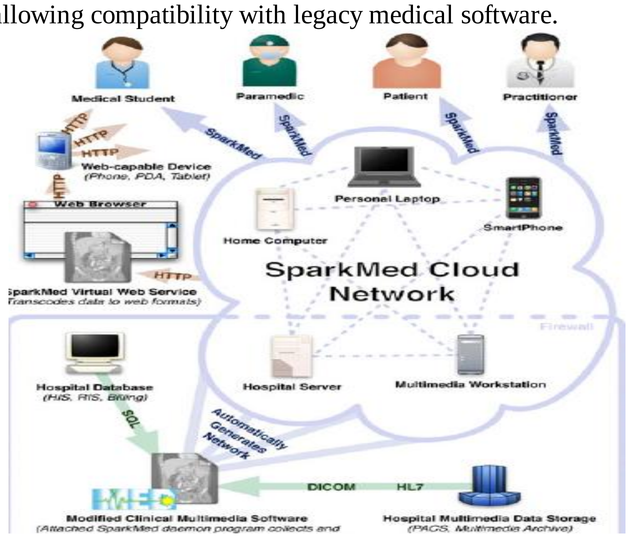

Fig.1.Architecture Diagram

II. SPARK MED CONCEPTS

SparkMed uses following concepts for images to be shared among series of mobile devices across multiple network configurations such as PACS and Cloud Network

A. PACS

Picture Archiving and Communication System(PACS) that is the most popular for health system architecture that has changed from radiographics film to digital imaging called a filmless system. The PACS or filmless information system is a combination of hardware and software, which is used to capture , store, distribute and display images with the Digital Imaging and Communication in Medicine (DICOM) standard.

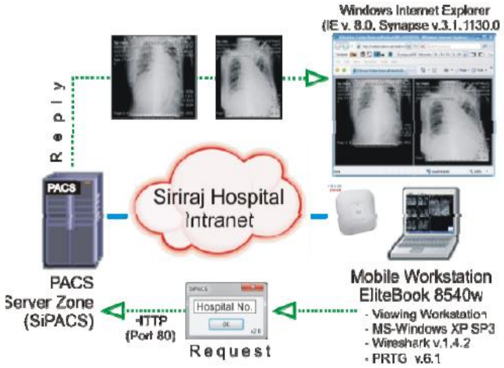

Fig.2. PACS servers and a sniffer Displays the network connection between computer

The PACS normally requires a high –speed network to transmit large picture between PACS's Server and viewing workstations because a constraint of PACS communication is defined as the desirability that one-way direction of each image should be displayed on a viewing workstation screen within 5 seconds known as Siriraj PACS's KPI. The health system uses medical imaging or picture Archiving and Communication Systems medicine and clinical information services such as X-ray, laboratory work, and medical record system (MRS) which are popularly delivered over wireless networks. A system with Wireless enables mobile carts to easily setup and be kept running. Figure 2 shows the network connection between PACS servers and sniffer computer that says an effect of variable on PACS flow with constraint of displaying the image on viewing workstation should be below 5 sec. PACS traffics analysis was represented as packet arrival time and packet length measured in bytes. This analysis is presented in terms of packet arrival time by time of day to understand congestion management the three traffic models are LAN, WAN and Intranet. It depends on the relationship of IP packets length and frequency.

B. CLOUD MODEL

Modern information technology is being increasingly used in the healthcare sector with the sole objective of enhancing the availability of improved medical services at reduced costs. Cloud model used for cost reduction and resource utilization, it not only reduce the development cost but improve the maintainability and adoption of evolving technologies. A cloud based information systems can offer new possibilities , such as easy and ubiquitous access to medical data, and opportunities to utilize the services of medical experts.

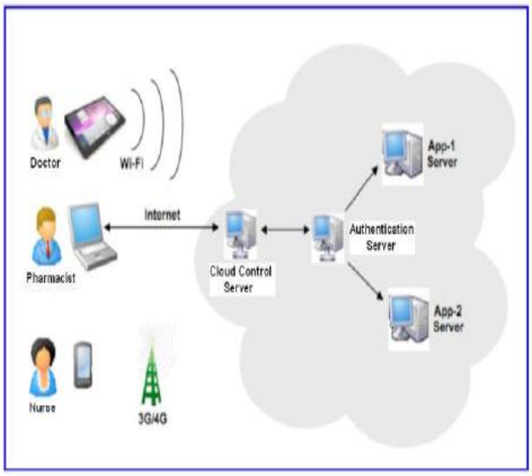

Fig.3.Architecture of Cloud Based Model for Healthcare Center

Cloud computing is a fast growing trend that includes several categories of service, all offered on demand over the internet in a pay-as -you-go model. It promises to increase the velocity with which applications are deployed , increase innovation , and lower costs. Using a Cloud Computing strategy for information support systems will help in conducting core business activities with less annoy and greater efficiency. Thousands of virtual machines and applications can be managed more easily using a cloud – like environment. Figure 3 shows the requirement of the Cloud based information system is to create secure, state-of-art facility to store the data available in different healthcare centers and to provide access to users in a secured manner, as per the roles and privileges.

Cloud control server is responsible for managing physical resources, monitoring the physical machines, placing virtual machines, and allocating storage. The controller reacts to new requests or changes in workload by provisioning new virtual machines and allocating physical resources.

Authentication server in cloud computing environment use Authentication and Authorization mechanism. Authentication means each user has an identity which can be trusted as genuine. This is necessary because some resources may be authorized only to certain users. Authorization is the mechanism in which a system determines correct user is using the system. . Figure 4 illustrate authentication mechanism whereby systems may securely identify their users.

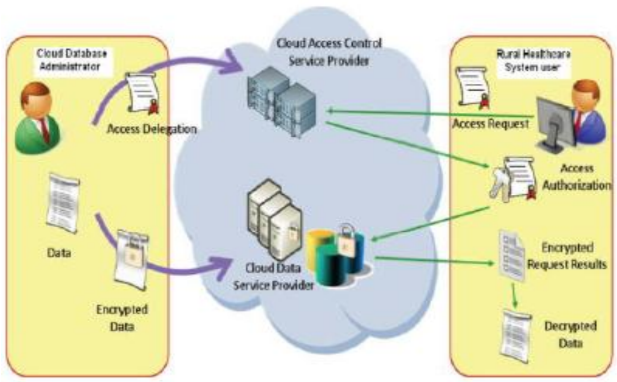

Fig.4.Authentication Server architecture

Authentication process

In this phase we are going to provide Authentication process to patients, medical student,

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paramedic and practitioner and encrypt these records to storing Hospital database for security purpose.

Generating Reports and Distribution of Medical Data
To generate user (patient, medical student, paramedic, practitioner) reports and to allow medical data applications to share data with mobile hosts over a wireless network and sharing multimedia medical data like media streaming and medical images

Disclosure verification process
Whenever an illegally disclosed medical image is found, the verification process is invoked on the PACS server to track the staff member who is responsible. Once, requesting the PID to PACS, generating reports extracted, the identification PID appearing on the report can be visibly recognized, thus identifying the suspicious staff member

III. SECURITY

Spark Med running as a mobile application or RIA, it establishes a TCP/IP connection and synchronizes the UI elements, variables, and file data between nodes. SparkMed implements an AJAX-like interface for XML-based communication of data and a simple HTTP server for serving files to allow easy web access of data. SparkMed has ability for mobile send to medical applications and transcode-and-forward their data, the cloud network created by SparkMed has the potential to extend the reach of hospital infrastructure to allow data access beyond the limitations of proprietary systems. SparkMed provide many profit of an off-site PACS or SOA. The major costs are storage and security in order to avoid prohibitive cost and infrastructure requirements of off-site-storage and prevent security risk of lost or stolen devices where the sparkmed information is held in memory without saving in the disk.

IV. IMPLEMENTATION

Our SparkMed framework was designed with radiological workflow and with centered on a server machine running a number of DICOM and HL7 data sources, the data are created as single medical workstation application as JPEG image. These images are shared among series of mobile devices across multiple network configurations. The images are stored in PACS,DICOM and HL7 formats on a radiology information systems implemented in FileMaker Pro. The data generated by radiologists are typically communicated to the referring physician/staff by means of analogue delivery methods (CD, printed report) or by email. Such delivery limits the varieties of media available, and transfers only a subset of the full diagnostic data from the RIS. By making use of this RIA subsystem, we have created a portable radiology workstation system that requires no installation and runs in any standard web browser on any Internet-capable device. It is fully DICOM compliant, and supports multimodality PET/CT navigation and fusion, allowing slices to be visualized in any orthogonal plane, or as a 3-D maximum intensity projection (MIP).

A. Simulation Experiment

A simulation experiment was conducted to evaluate the interactive usability and overhead costs of our SparkMed framework, under the expected network conditions for normal use in a medical environment. Our simulation was modeled after a radiological workflow, and as such was centered on a server machine running a number of DICOM and HL7 data sources (medical imaging software expanded with our SparkMed daemon component to become networkable nodes). These data sources were combined to create a single medical workstation application, which used SparkMed to retrieve the necessary multimedia data, and transcode image data to lossless JPEG format. Multimodality data sources (e.g., DICOM JPEG) were first split into their component parts (e.g., DICOM metadata and JPEG image data) in order to deploy them as Shared Data. Finally, this application was synchronized to a series of mobile devices using the SparkMed framework, thus turning this SharedData into a self-synchronizing network.
In Table I. Mobile SparkMed nodes were connected alternately using WiFi and 3G Internet connections

TABLE I
DEVICES USED IN SPARKMED

Device	Description	Processor	Memory	Connectivity	OS
Device 1	Apple iphone 3G	412MHz	128MB	Wi-Fi/3G	Apple iOS 4.2
Device 2	Apple iphone 4(GSM)	1GHz	512MB	Wi-Fi/3G	Apple iOS 4.1
Device 3	Apple iPad	1GHZ	256MB	Wi-Fi	Apple iOS 4.3.3

Under each of these configurations, the following variableswere measured.

1) Propagation time—the time it takes for data to fully propagate through the network, i.e., the time between registering a change in its value, and the entire network having been brought up-to-date. This includes both the transmission time and the time taken to confirm that all nodes are sync.
2) Frames per second—measuring the FPS of medical image rendering performance observed.
3) Memory usage—the increase in memory use the host application observes, recorded to allow measuring of the memory overhead of SparkMed.
4) Bandwidth usage—the rate, in KB/s, at which SparkMed sends and receives data.
5) Processor load—the increase in strain the central processing unit is under. This represents the overhead added by SparkMed to the base application. Because processor load tended toward inconsistency due to "peaks" in the data,samples were averaged over ten iterations. In our study, our criterion for acceptably interactive performance was a "near-real-time" updating of the device's data and visualization content as it was manipulated at the remote side.

B. Results Analysis

SparkMed performance lies within our targeted "near-real-time" performance over WiFi and retains usable performance under 3G. Further, the protocol recovers gracefully from errors, and can retain this performance for each application with a much larger number of users if a nonhandheld device is the central node. The overhead from implementing SparkMed is relatively low, although memory usage rises steeply if

SparkMed's intended usage parameters. The SparkMed application networks itself automatically and the required data items are then automatically synchronized by the SparkMed framework: the remote user is immediately delivered the same database data, metadata, imagery, and variables in use on the initiator's machine (or machines), at which point he/she is able to manipulate each connected system directly, with results visible immediately to both parties. With collaboration thus established, meaningful diagnostic discussion can occur.

V. CONCLUSION

The SparkMed framework allows us to access multimedia medical data from a various mobile devices effectively with security also with low cost SparkMed architecture in an environment designed to simulate a real hospital and telemedicine setting. Within the context of our simulated radiological workstation, our prototype demonstrated highly interactive usability and low overhead cost requirements, proving its suitability and effectiveness in similar hospital contexts.

FUTURE WORK

Future work will improve more fine-grained QoS through the use of redundant datastreams at varying bit rates; improvements to its ability for real-time visualization and will also expand our framework to incorporate scalability and QoS issues which are expected to largely optimize our performance.

REFERENCES

1. Foundation for the National Institutes of Health. (2009). The InauguralmHealth (mobile health) Summit, Washington D.C.[Online].Available:http://www.fic.nih.gov/news/events/mhealth summit.htm
2. D. Vatsalan, S. Arunatileka, K. Chapman, G. Senaviratne, S. Sudahar, D.Wijetileka, and Y. Wickramasinghe, "Mobile technologies for enhancingeHealth solutions in developing countries," in Proc. 2nd Int. Conf. eHealth,Telemed., Soc.Med., eTELEMED 2010, IncludesMLMB2010; BUSMMed 2010, pp. 84–89.
3. R. Istepanian, C. S. Pattichis, and S. Laxminarayan, "Ubiquitous mhealth systems and the convergence towards 4G mobile technologies," in M-Health: Emerging Mobile Health Systems. New York: Springer- Verlag, 2005, pp. 3–14.
4. J. A. Hernandez, C. J. Acuna, M. V. de Castro, E. Marcos, M. Lopez, and N. Malpica, "Web-PACS for multicenter clinical trials," IEEE Trans. Inf. Technol. Biomed., vol. 11, no. 1, pp. 87–93, Jan. 2007.
5. I. Balasingham, H. Ihlen, W. Leister, P. Roe, and E. Samset, "Communication of medical images, text, and messages in inter-enterprise systems: A case study in Norway," IEEE Trans. Inf. Technol. Biomed.
6. A. Rosset, L. Spadola, and O. Ratib, "OsiriX: an open-source software for navigating in multidimensional DICOM images," J. Digital Imag., vol. 17, no. 3, pp. 205–216, Sep. 2004.
7. A. Kailas, C. Chong, and F. Watanabe, "From mobile phones to personal wellness dashboards," IEEE Pulse, vol. 1, no. 1, pp. 57–63, Jul.–Aug 2010.
8. 2007 IBM Report on Health Care. (2007), "Healthcare 2015: Win-win or lose-lose? A portrait and a path to successful transformation," IBM Institute forBusinessValue, pp. 1–8. [Online].Available: http://www-935.ibm.
9. J. Philbin, F. Prior, and P. Nagy, "Will the next generation of PACS be sitting on a cloud?" J. Digital Imag., vol. 24, no. 2, pp. 179–183, Apr. 2011.
10. C. Costa, C. Ferreira, L. Bastiao, L. Ribeiro, A. Silva, and J. L. Oliveira, "Dicoogle—An open source peer-to-peer PACS," J. Digital Imag., vol. 24, no. 5, pp. 848–856, Oct. 2010.
11. Merge Healthcare, Inc. (2011, Jun. 1). "AMICAS PACS—The first 100% web-based PACS system," [Online]. Available: www.merge.com/ products/pacs/amicas-pacs/index.aspx
12. S. G. Langer, "Challenges for data storage in medical imaging research," J. Digital Imag., vol. 24, no. 2, pp. 203–207, Apr. 2011.
13. T. J. Farnsworth, "PACS for imaging centers," Radiol. Manage., vol. 25, no. 3, pp. 36–41, 2003.
14. S. B. El-Ghatta, T. Clade, and J. C. Snyder, "Integrating clinical trial imaging data resources using service-oriented architecture and grid computing," Neuroinformatics, vol. 8, no. 4, pp. 251–259, Dec. 2010
15. T.-H. Yang, Y. S. Sun, and F. Lai, "A scalable healthcare information system based on a service-oriented architecture," J. Med. Syst., vol. 35, no. 3, pp. 391–407, Jun. 2011.
16. B. Silverman, O. Sokolsky, V. Tannen, A. Wong, and L. Lang, "HOLON/CADSE: Integrating open software standards and formal methods to generate guideline-based decision support agents," in Proc. AMIA Annual Symp., 1999'.
17. R. Kapitza, H. Schmidt, G. Soeldner, and F. Hauck, "A framework for adaptive mobile objects in heterogeneous environments," in OTM Conference (Lecture Notes in Computer Science). New York: Springer, 2006, pp. 1739–1756.
18. W. Grimson, D. Berry, J. Grimson, G. Stephens, and E. Felton, "Federated healthcare record server—the Synapses paradigm," Int. J. Med. Informat., vol. 52, no. 1, pp. 3–27, 1998.
19. D. Sullivan, K. Farion, S. Matwin, and W. Michalowski, "A conceptbased framework for retrieving evidence to support emergency physician decision making at the point of care," in Knowledge Management for Health Care Procedures, (Lecture Notes in Computer Science vol 4924), 2008, pp. 117–126
20. M. Tsiknakis, M. Brochhausen, J. Nabrzyski, and J. Pucacki, "A semantic grid infrastructure enabling integrated access and analysis of multilevel biomedical data in support of postgenomic clinical trials on cancer," IEEE Trans. Inf. Technol. Biomed., vol. 12, no. 2, pp. 205–217, Mar. 2008.

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