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Internet of Stings: Securing Healthcare Records Applying Internet of Things

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Abstract— *This paper investigates the role of Internet of Things(IoT) in securing Electronic Healthcare Records (EHRs). Personal health record (PHR) has emerged as a patient centric model of health information exchange. Day by day health issues and health problem concerns are increasing. So many people are facing health problems and are getting admitted in to the health care centers. So to maintain the details of all the patients in a hospital is a difficult task. Hospitals have to maintain the records of each and every inpatient. In some cases patients may even have to wait for long time to consult the doctor. Also if the concerned doctor is not available in the hospital then the nurses have to call him and ask the related queries according to the inpatients condition. A PHR service allows a patient to create, manage and control her personal health data in one place through the web, which has made the storage, retrieval and sharing of the medical information more efficient. Especially each patient is promised the full control of their medical records and can share her health data with a wide range of users, including healthcare providers, family members or friends. In this paper we provide a description of how the internet of things can be supported to ensure security for distributed health care applications. This paper would promote a lot of research in the area of application of IoT in securing PHRs.*

Keywords- Internet of Things, Cloud Computing, Big Data, Service Oriented Architecture, Health care systems.

I. INTRODUCTION

Internet of Things (IoT) has major advantages, but it also has disadvantages too. The issues encountered by the authors are interoperability and security in the case of healthcare system. All the health data are considered to be the personal private data and those data should need security. Like confidentiality, integrity, authority should be preserved in the case of medical data. The author noted that IOT interoperability issues are still not being considered a problem to develop a data transfer system connecting health care providers with patients. Some middleware proposals use SOA (Service Oriented Architectures) in embedded Networks middleware is in need for standards to improve interoperability of devices especially in the case of healthcare devices. Ubiquitous health model is also in existence. In this model, the individual medical data was measured by ubiquitous personal health device (UHD) and the information is sent to the health service will provide feedback to the medical experts and patients. It is clear that, the analysis and processing function of medical data were done in the server only Conclusion: We provide a description of how the internet of things can be the main enables for distributed healthcare applications and controversially, how to solve issues and challenges in SUN Computing.

The rest of the paper is organized as follows: section 2 describes a conceptual security framework for personal health records (PHRs). Section 3 gives a broad overview of an electronic patient record implementation using clinical document architecture. Section 4 gives a detailed view on a cloud-based semantic wiki for user training in healthcare process management. Section 5 portrays E-EPR: a cloud-based architecture of an electronic emergency patient record. Specifying process requirements for holistic care is depicted in Section 6. Section 7 speaks about Access Control Framework for Pervasive Mobile Healthcare Systems Utilizing Cloud Services. Section 8 speaks about web-based workflow system for emergency healthcare Section 9 speaks about SPECIFYING Workflow Process Requirements for an Emergency Medical Service. Section 10 concludes the paper giving the future research direction.

II. A CONCEPTUAL SECURITY FRAMEWORK FOR PERSONAL HEALTH RECORDS (PHRS)

Mikaelapoulymenopoulou, Despinapapakonstantinou, Floramalamateniou, Andriana Prentza and George (2013) say that generally patients health record should be governed very securely. Even health records are maintained by electronic systems too. The above authors quoted that electronic personal health record(PHR) is a citizen centric information. It further allows citizens to control their personal information. And the authors noted that ideal PHR should allow citizens to connect with their caregivers like family members and together maintain their health and social information. Though it is

very effective, but it leads to specific challenges in terms of security. Security is more important in medical data. If the data is insecure then there is no way of using the electronic PHR system. In electronic PHR system, in some cases multiple parties make entries and require access to PHR data. Since non domain experts are considered impossible to control all the health information. In this work, the above authors presented a Conceptual security framework for the employment of an attribute based PHR access control policy. This framework will be continually updated according to the health provider's local security policies and individual professionals and citizen sharing preferences.

III. AN ELECTRONIC PATIENT RECORD IMPLEMENTATION USING CLINICAL DOCUMENT ARCHITECTURE

M.Poulymenopoulou And G. Vassilacopoulos (2004) spells that anciently, the patient's health records are maintained in papers, booklets, registries etc.After the evolution of computers, health records have been maintained in a small database. But an Electronic patient's record should provide the means of integration that may be scattered across dispersed healthcare organizations. Generally, it uses heterogeneous systems in order to support their internal functions. The authors noted that XML language and Clinical document architecture (CDA) provides a mechanism for defining,structuring, manipulating and visualizing patient medical data using the same semantics through web .In this paper, a prototype implementation of a web based electronic patient record system using XML for data format and CDA for defining and structuring patient clinical documents is presented by the authors.

IV. A CLOUD-BASED SEMANTIC WIKI FOR USER TRAINING IN HEALTHCARE PROCESS MANAGEMENT

Mikaela Poulymenopoulou, Despinap Apakonstantinou, Flora Malamateniou and George Vassilacopoulos (2010). Successful healthcare process design requires active participation of users who are familiar with the cooperative and collaborative nature of healthcare delivery, which is expressed in terms of healthcare processes. Hence a flexible, agile and adaptable training material is needed with the objective to enable users instill their knowledge and expertise in healthcare process management and reconfiguration activities. The authors noted that, social software called as WIKI, could be used as it supports cooperation and collaboration anytime, anywhere and combined with semantic web technology that enables structuring pieces of information for easy retrieval, reuse and exchange between different systems and tools. In this paper, the above authors proposed a semantic wiki is presented as a means for developing training material for healthcare providers regarding healthcare process management. The semantic wiki should act as a collective online memory containing training material that is accessible to authorized users, thus enhancing the training process with collaboration and cooperation capabilities. It is proposed that the wiki is stored in a secure virtual private cloud that is accessible from anywhere, be it an excessively open environment, while meeting the requirements of redundancy, high performance and auto scaling.

V. E-EPR: A CLOUD-BASED ARCHITECTURE OF AN ELECTRONIC EMERGENCY PATIENT RECORD

M. Poulymenopoulou, F. Malamateniou, G. Vassilacopoulos (2010) argues that at the time of emergency healthcare delivery past medical record of the patient is needed, so that immediate emergency care can be taken to the patient and the risk of the emergency and the emergency length can be found. The pervasive accesses to the integrated emergency information are needed, in order to diagnosis and follow the treatment procedures effectively and efficiently at the emergency care time. In this paper, a cloud based service-oriented architecture(SOA) is used for making electronic emergency patient record system(E-EPR) that could be pervasively access and support several applications and platforms, that manages the records in a distributed manner. This system can be integrated with ambulance and the hospital information system since it is open- wide pervasive standard that could be used for easy treatment and diagnosis of the patient during the emergency medical care.

VI. SPECIFYING PROCESS REQUIREMENTS FOR HOLISTIC CARE

Mikaela Poulymenopoulou, Flora Malamateniou And George Vassilacopoulos (2013) refer, holistic as to health and social care which aims at providing comprehensive care to the community. Especially to elderly people and people with multiple illnesses. Probably, this requires using health and social care resources more efficiently through enhanced collaboration and coordination among the corresponding organizations and delivering care closer to patient needs and preferences. This paper takes a patient-centered, process view of holistic care delivery. It focuses on requirements elicitation for supporting holistic care processes and enabling authorized users to access integrated patient information at the point of care when it is needed. The authors noted that an approach to holistic care process-support requirements is presented which is based on business process modeling, collaboration, coordination and information sharing among health and social care organizations by actively involving users .It is done by providing insights for alternative process designs. This approach provides a means for integrating diverse legacy applications in a process-oriented environment using a service-oriented architecture as a solution for supporting and automating holistic care processes. This approach is applied in the context of

emergency medical care aiming at streamlining and providing support technology to cross-organizational health and social care processes to address global patient needs.

VII. AN ACCESS CONTROL FRAMEWORK FOR PERVASIVE MOBILE HEALTHCARE SYSTEMS UTILIZING CLOUD SERVICES

Mikaela Poulymenopoulou, Flora Malamateniou (2012) invaded the vision of "Pervasive Health care" can also obtain with affiliation of mobile and cloud computing by enabling the authorized healthcare participants, so that they could access the healthcare information without any restrictions like locations, time and other constraints. Thus doing this system could protect the healthcare records of the patient in a confidential manner. On this basis, this paper proposes a framework control access for providing role-based context-aware authorization services that could seek the regard services and accesses the patient confidential records. Conceding to this proposal, authorized decisions are taken according to condition restraint that results in domain theory collection that can be used in the context information.

VIII. A WEB-BASED WORKFLOW SYSTEM FOR EMERGENCY HEALTHCARE

Mikaela Poulymenopoulou And George Vassilacopoulos (2001), authors through this paper expells that emergency healthcare delivery has got a variety and a series of activities that are to performed on time from the call received from the patient to the service of the ambulance until the patient is disposed from the emergency department in a hospital. According to the author, the workflow systems in the recent times have received a good amount of consideration and attention in the field of healthcare as they overcome the structures of the organization, and they support co-ordination requirements as well as collaboration through routing related information automatically as and when required. The author also states particularly about the workflow systems of healthcare that are implemented over web, forms the base for the collaborative work by making all the healthcare professionals who are at the corners of the world to work together and thereby it creates a virtual group for the care of the patients. The author in this paper has presented a web based workflow system in order to support the emergency situation of healthcare. He has also provided an infrastructure in order to integrate the in-hospital and pre-hospital emergency healthcare.

IX. SPECIFYING WORKFLOW PROCESS REQUIREMENTS FOR AN EMERGENCY MEDICAL SERVICE

Mikaela Poulymenopoulou, Flora Malamateniou And George Vassilacopoulos (2003) states that, because of the trends in the delivery of the healthcare in the recent times, it has made a shift gradually in the concepts of information system of the healthcare which supports the process of healthcare in a more prominent and in a direct way. The gradual shift towards the integrated and managed care requires the design of healthcare process according to the need of patients and implementing the considerations based on its efficiency, has created more interest in healthcare information system in process oriented way which is based on the workflow technology. This can be explained as delivering the tasks that are to be performed to the right individuals at the correct time along with the required information and applications. The author also states that, this workflow technology promotes the development of component oriented technology wherein the application logic is varied from the process logic. Through this paper, the author presents an effective way to capture the requirements of process logic for the workflow system along with the view of designing a system which can be adjustable easily to the changes in process and also to evolve a structure in the organization at a low and a reasonable cost.

X. CONCLUSION AND FUTURE WORK

This paper investigates the role of Internet of Things (IoT) in securing Electronic Healthcare Records (EHRs). Personal health record (PHR) has emerged as a patient centric model of health information exchange. Day by day health issues and health problem concerns are increasing. So many people are facing health problems and are getting admitted in to the health care centers. So to maintain the details of all the patients in a hospital is a difficult task. Hospitals have to maintain the records of each and every inpatient. In some cases patients may even have to wait for long time to consult the doctor. Also if the concerned doctor is not available in the hospital then the nurses have to call him and ask the related queries according to the inpatients condition. A PHR service allows a patient to create, manage and control her personal health data in one place through the web, which has made the storage, retrieval and sharing of the medical information more efficient. Especially each patient is promised the full control of their medical records and can share her health data

with a wide range of users, including healthcare providers, family members or friends. In this paper we provide a description of how the internet of things can be supported to ensure security for distributed health care applications. This paper would promote a lot of research in the area of application of IoT in securing PHRs.

APPENDIX

S.No.	Paper Title	Problem Addressed	Proposed Solution Methodology/ Strategy/ Algorithm/Architecture
1.	A Conceptual Security Framework For Personal Health Records(PHRs)[2013]	The health records are also linked with the caregiver. They may misuse the confidential records of the citizen.	The system gives the attribute based PHR access control policy so that it gives authentication to provider by local security policies, professional, and citizen sharing preferences.
2.	An Electronic Patient Record Implementation Using Clinical Document Architecture.[2004]	Clinical document architecture(CDA) provides a mechanism for defining ,structuring, manipulating etc.,	A prototype implementation of a web based electronic patient record system using XML for data format and CDA for defining and structuring patient clinical documents is presented by the authors.
3.	A cloud-based semantic wiki for user training in healthcare process management [2010]	For successful healthcare processes, a flexible, agile and adaptable training material is needed as social software.	A semantic wiki is presented as a means for developing training material for healthcare providers regarding healthcare process management.
4.	E-EPR: a cloud-based architecture of an electronic emergency patient record.[2011]	In emergency cases, patient record is not found, since it is not integrated.	This paper gives us the centralized data storage of emergency medical care record which is integrated with ambulance and hospital, so that it is easy for treatment and easy for diagnosis during emergency medical care.
5.	Specifying process requirements for holistic care [2013]	Holistic refers to social and health, but it is without integration.	Integrating diverse legacy applications in a process-oriented environment using a service-oriented architecture as a solution for supporting and automating holistic care processes.
6.	An Access Control Framework for Pervasive Mobile Healthcare Systems Utilizing Cloud Services [2012]	The open-wide Health care can obtained by integrating mobile devices and cloud computing, so that the health care information can be accessed without any restrictions to keep the patient record.	This paper proposes a framework to control the access to the confidential patient medical records. The confidential records are collect based on the domain theory according to the background principle.
7.	A web-based workflow system for emergency healthcare[2001]	The workflow systems in the recent times have received a good amount of consideration but without the collaboration of in-hospital and pre-hospital healthcare.	The authors provided an infrastructure in order to integrate the in-hospital and pre-hospital emergency healthcare.

8.	Specifying Workflow Process Requirements for an Emergency Medical Service [2003]	Process oriented logic	Component oriented technology in the application logic
9.	Emergency Healthcare Process Automation Using Mobile Computing and Cloud Services[2012]	To provide a medical care beyond basic holistic principle, EMS and social care services offer s psychological and social support. EMS and social care is in need of entire information about the patient to the care provider anywhere and anytime with authorized user.	Workflow based electronic patient record(E-EPR) is provided as a cloud.many organisation are similar as EMS and social care services,the E-EPR is built at the top of the integrating healthcare enterprise(IHE) based on collaborative network consists of original EMS agency and social care providers who shares the document as IHE based profiles.
10.	Ontology-Driven Authorization Policies on Personal Health Records for Sustainable Citizen-Centered Healthcare	The patient could store the medical report/health care report by themselves from various sources in virtual PHR.To access virtual PHR,it is challenging and points that it is in need of data share policy based on interoperability platform.	To resolve this,they proposed a model called authorization system for virtual PHR based semantic technologies as a cloud services. they also modelled role and attribute based access control model that supports various authorization policy,that have a rule to broadcast that data according to the user request.
11.	Enhancing Patient Information Sharing Through Social Networks	There are many online advanced healthcare services.This services require increased level of information flow and collaboration among patient and healthcare professionals. This collaboration can also be shared by combining the record and social network functionality. hence social network is web-based broadcasting system, also impractical in healthcare	Creating secure middleware which shares the PHR to patient and healthcare professionals through social network functionality and application by giving particular importance to security architecture.

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