A Novel Activity Flow Model for Effective Protection of Electronic Health Records (EHRs) in Cloud

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ABSTRACT: This paper proposes new methods to effectively guard Electronic Health Records (EHRs). Privacy-An important factor need to be considered while we publishing the microdata. Usually government agencies and other organization used to publish the microdata. On releasing the   microdata, the sensitive information of the individuals are being disclosed. This constitutes a major problem in the government and organizational sector for releasing the microdata. In order to sector or to prevent the sensitive information, we are going to implement certain algorithms and methods. Normally there two types of information disclosures they are: Identity disclosure and Attribute disclosure. Identity disclosure occurs when an individual's linked to a particular record in the released Attribute disclosure occurs when new information about some individuals are revealed. This paper aims to discuss the existing techniques present in literature for preserving, incremental development, activity flow model and modular workflow model of the system proposed.

KEYWORDS: Electronic Health Records(EHRs0, Privacy, Microdata, Medical Healthcare System, Database Security.

I. INTRODUCTION

Cloud computing appears to be focused on large scale of storage of information across multiple servers. Cloud computing undergoes several style of resources such as dynamism, abstraction and resource sharing. Day by day health issues and health problems are increasing so to maintain and monitor health data is important.

Cloud based technique helps health and clinical organization to concentrate more on improving quality of service of their health operations. MYPHR machine is a patient centric system. MYPHR are appealed to be the next generation consumer-centric information system that helps progress health care delivery, self-management and wellness by providing flawless and complete information, which increases understanding, capability and awareness. MYPHR machine designed to solve the problem in the health record portability and provide a tight bond relationship with the doctor or the institution and the patient. Main aspect of MYPHR machine design is to make the PHR data as portable.
The remainder of the paper is organized as follows. Section 2 deals about Survey of Literature of Techniques prevailing to protect EHRs. Basic Primitives and Terminologies are discussed in Section 3. Section 4 discusses about the initial architectural representation of security system for cloud based PHRs. The Proposed Architectural Representation and its discussion is briefed in Section 5. Section 6 discusses about the Activity Flow Model for proposed architecture. The modular workflow of proposed system is depicted in Section 7. Section 8 enumerates the advantages of the proposed system. Section 9 concludes the paper and outlines the direction for Future Work.

II. LITERATURE SURVEY

Richard S. Surwit, Lyle M. Allen, III, Sandra E. Cummings (2000) proposed "Systems, methods and computer program products for monitoring, diagnosing and treating medical conditions of remotely located patients" which explore the patient monitoring systems with medical conditions of remotely located patients are treated, diagnosed and monitored by a central data processing system to communicate with and receive data from particular patient monitoring systems which includes receiving and storing patient data along the medical dosage algorithm to generate medical dosage for the stored patient. A central data processing consists of medial dosage algorithm, obtain each patient data and define medical prescriptions of each individual patient. Also modifications of medicine dosage and treatment information's are communicated directly to a patient or to a patient monitoring system.

Marc Edward Chicorel (2001) [21] proposes "Computer keyboard-generated medical progress notes via a coded diagnosis-based language" explained that A medical progress documentation system using an ordered "language" of codes which consists of at least two alphabets, when entered into a programmed processor in a specific arrangement it generate an expressive sentence showing predetermined, frequently used processes in a medical office.

Charlyn Jordan (2002) [22] proposed "Health analysis and forecast of abnormal conditions" explored that Tracking the health status of a patient and entering range of health record signals each signal are measured with the predetermined health indicative function defined to be in normal range to the health report of the patient taken at different time.

Jeffrey J. Clawson (2003) [23] defined "Method and system for an improved entry process of an emergency medical dispatch system" which explore a developed system for processing, receiving and responding to emergency medical calls by emergency dispatchers is defined.

PekkaRuotsalainen (2004) [24] in "A cross-platform model for secure Electronic Health Record communication" defined that secure and sharing of distributed patient information. Roger J. Quy (2005) [25] in "Method and apparatus for health and disease management combining patient data monitoring with wireless internet connectivity" defined that a function which provides a method for a wireless health monitoring system for monitoring a health condition of a patient by connecting an internet enabled wireless device ("WWD") to a health monitoring device.

Avner Amir, Avner Man (2006 a) [26]in "System and method for administration of on-line healthcare" define A healthcare administration system provides the management of anamnesis and medical records, data analysis, guided diagnosis, medical treatment and clinical investigation. It has common medical information protocol (CMIP) used for the controlling, monitoring and treatment process and its outcome by means of a medical protocol.

Christopher Alban, Khiang Seow (2007) [28] defines a "Clinical documentation system for use by multiple caregivers" they explain that A computer based system for recording, storing, accessing and retrieving clinical documentation where the care setting is provided.

Brian A. Rosenfeld, Michael Breslow (2008) [29] in "System and method for accounting and billing patients in a hospital environment" explored that a system developed for accounting and billing patients in hospital environment. Patient identifier is associated with the billing service provided by the hospitalized unit.

Jacquelyn Suzanne Hunt, Joseph Siemienczuk (2009) [30] in "Process and system for enhancing medical patient care" explored that a system that abstracts selected information. Traditional electronics medical records involves in analysis of a determined medical complaints shared by multiple patients.

Richard J. Schuman (2010) [31] defines "Health care computer system" which define the A hospital bed, patient and nurse call system. A hospital network is provided. Communication is provided over a packet based communication network.

Kanagaraj, G.Sumathi, A.C. (2011) [32] in "Proposal of an open-source Cloud computing system for exchanging medical images of a Hospital Information System" proposed clinical information system through the cloud can provide the essential details to the health care

AvulaTejaswi, NelaManoj Kumar, GudapatiRadhika, SreenivasVelagapudi (2012 a) [33] in "Efficient Use of Cloud Computing in Medical Science" explored that redesign of medical system with the advent of cloud computing is handled to carry out the information of the patient details in sophisticated manner with less cost and minimum time. They explained the implementation of the cloud computing in hospitals for better cure for the diseases use cloud security protocol for record management. Only authenticated doctors can access.

Carmelo Pino and Roberto Di Salvo (2013) [35] in "A Survey of Cloud Computing Architecture and Applications in Health" explained that cloud computing act as an important alternative to ensure high performance data processing and manage the tool in easy manner.

K.S. Aswathy, G. Venifa Mini (2014 a) [36] in "Secure Alternate Viable Technique of Securely Sharing the Personal Health Records in Cloud" proposed a cloud environment for resource sharing it involves in exchange of personal health record between multiple caregivers.

III. BASIC PRIMITIVES AND TERMINOLOGIES

Cloud environment may describe a company, organization or an individual who uses a Web based application for every mission rather than installing software and storing data on a computer. Cloud environment involves in provide a functionality to outsource and encrypt the data.   Cloud storage service is accessed through the cloud computer service, web service application programming interface or by a cloud storage gateway. The cloud based workspace is centralized providing easy functionality to share. The cloud environment can provide improvements in system efficiency & density. Cloud environment solve the problem of complicated configuration management, Decreased productivity, Limited accessibility and Poor collaboration. It has the capability to access all work, databases and other information from any device. Cloud environment involves in providing some basic network model for storage of data in the cloud. The basic network model for the cloud data storage and three different network entities are

1.   User
2.   Cloud storage server
3.   Cloud service provide

a.   **User**: An entity which has large data files to be stored in the cloud and relies on the cloud for data maintenance and computation can be either individual consumers or organizations.

b.   **Cloud Storage Server (CSS)**: An entity which is managed by Cloud service provider. Cloud storage is a subgroup of cloud computing. Cloud computing organizations offer users access to not only storage, but also processing power and computer applications mounted on a remote network. Cloud storage provides users with instant access to a wide ranging of resources and applications hosted in the infrastructure of another organization through a web service interface. Security of stored data and data transfer may be a concern during storing the sensitive data at a cloud storage provider.

c.   **Cloud Service Provider (CSP)**:A cloud provider is a company that compromises some constituent of cloud computinghas significant storage space and computation resource to maintain the user data. The Data owner encrypted some keywords about his data, and service provider supported the owner to retrieve his data by keywords and not allow others to retrieve. When supposing the role of cloud provider, an organization is accountable for making cloud services available to cloud customers.

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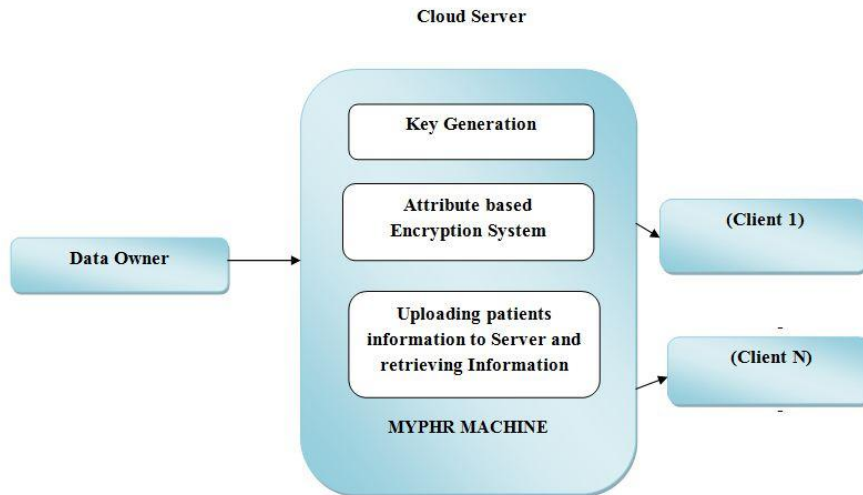## IV. INITIAL ARCHITECTURAL REPRESENTATION

Fig 1 Architectural Representation of Existing System
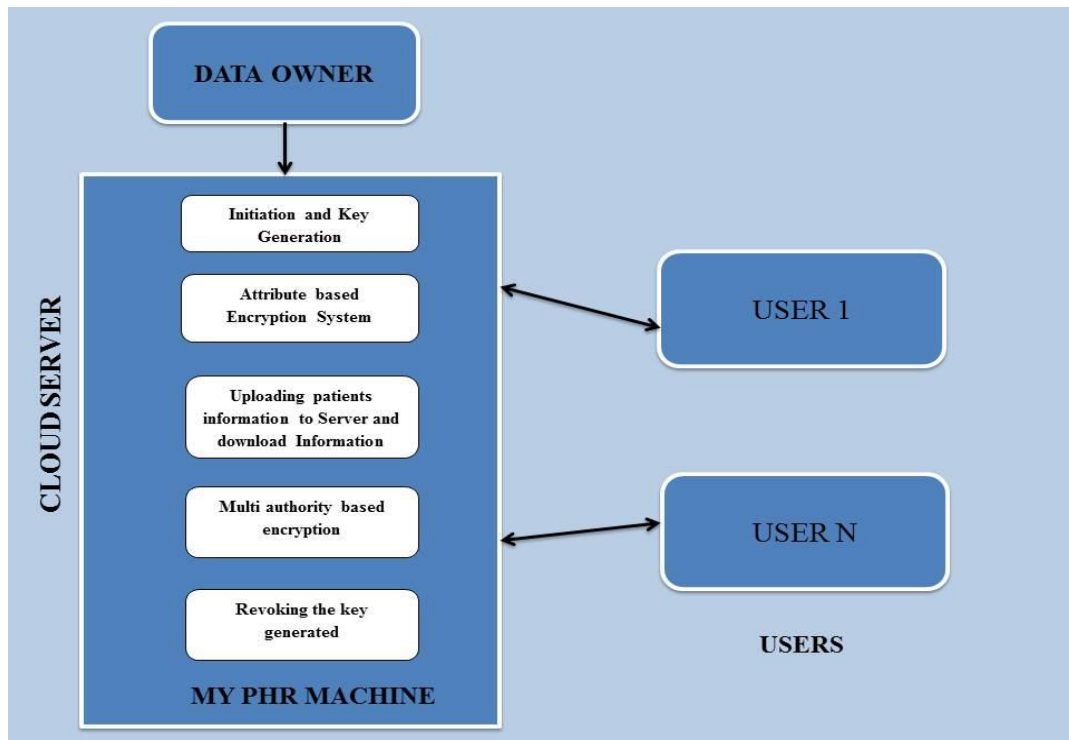
V. ADVANCED ARCHITECTURAL REPRESENTATION

Fig. 2. Architectural Representation of Proposed System

VI. ACTIVITY FLOW MODEL FOR PROPOSED ARCHITECTURE

UML 2 activity diagrams   are typically used for business process modeling, for modeling the logic captured by a single use case or usage scenario, or for modeling the detailed logic of a business rule. Although UML activity diagrams could potentially model the internal logic of a complex operation it would be far better to simply rewrite the operation so that it is simple enough that you don't require an activity diagram. In many ways UML activity diagrams are the object-oriented equivalent of flow charts and data flow diagrams (DFDs) from structured development. Activity diagrams can show activities that are conditional or parallel. Activity diagrams should be used in conjunction with other modeling techniques such as interaction diagrams and state diagrams. The main reason to use activity diagrams is to model the workflow behind the system being designed. Activity Diagrams are also useful for: analyzing a use case by describing what actions need to take place and when they should occur; describing a complicated sequential algorithm; and modeling applications with parallel processes. However, activity diagrams should not take the place of interaction diagrams and state diagrams.

Activity diagrams do not give detail about how objects behave or how objects collaborate.

Building block elements in an Activity Diagram are:

- Initial Node

An initial or start node is depicted by a large black spot.

- Final Node

There are two types of final node: activity and flow final nodes. The activity final node is depicted as a circle with a dot inside. The flow final node is depicted as a circle with a cross inside. The difference between the two node types is that the flow final node denotes the end of a single control flow; the activity final node denotes the end of all control flows within the activity.

- Fork and Join Nodes:

Forks and joins have the same notation: either a horizontal or vertical bar (the orientation is dependent on whether the control flow is running left to right or top to bottom). They indicate the start and end of concurrent threads of control. A join is different from a merge in that the join synchronizes two inflows and produces a single outflow. The outflow from a join cannot execute until all inflows have been received. A merge passes any control flows straight through it. If two or more inflows are received by a merge symbol, the action pointed to by its outflow is executed two or more times.

- Decision and Merge Nodes:

Decision nodes and merge nodes have the same notation: a diamond shape. They can both be named. The control flows coming away from a decision node will have guard conditions which will allow control to flow if the guard condition is met.
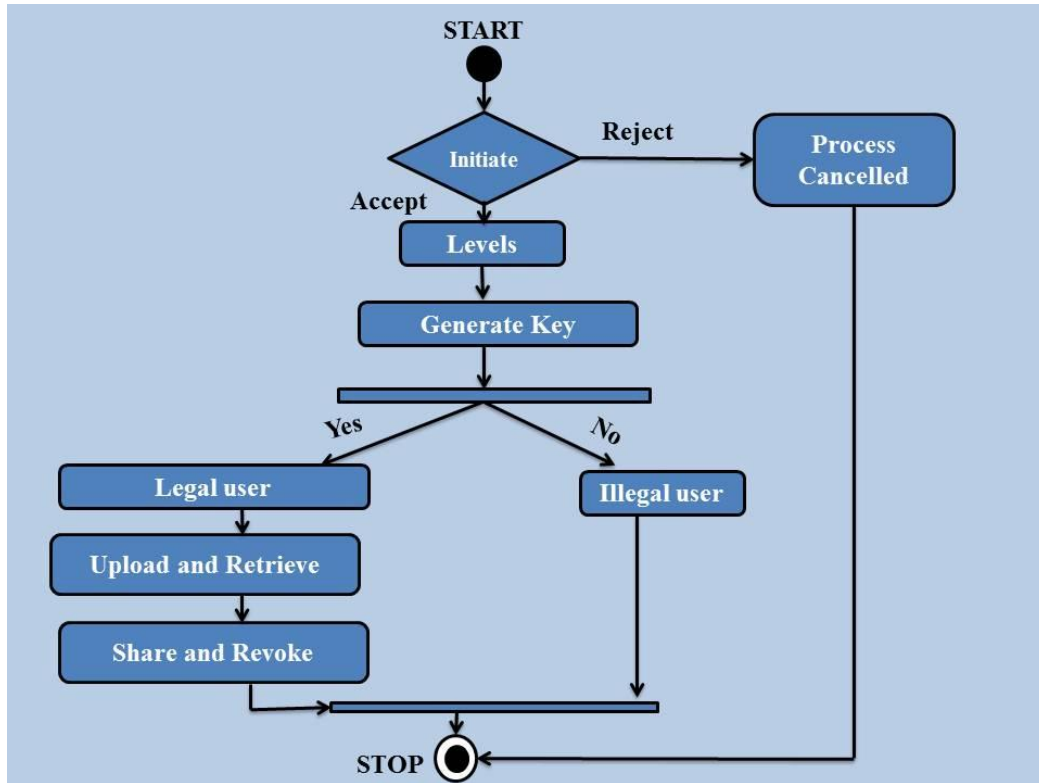
Fig. 3. Activity Flow Model for Proposed Architecture
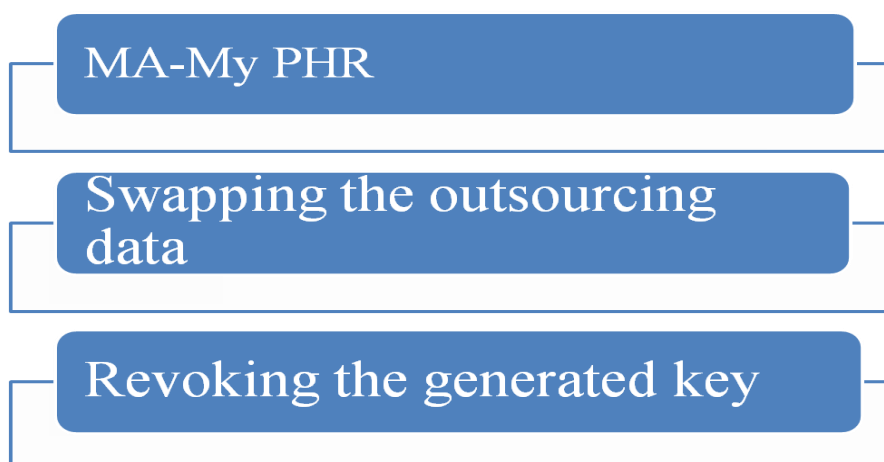
VII.   MODULAR WORKFLOW OF PROPOSED SYSTEM

Fig. 4. Modular Workflow of Proposed System

VIII.   ADVANTAGES OF THE PROPOSED SYSTEM

- My PHR machines efficiently identify the patients in the cloud server and additionally multi authority assigned to the patients.
- Multi authority based encryption with My PHR system (MA-My PHR)which it will have many attribute authority for handling the different set of users.

- Each user will be having different access control mechanism based on the relation with the patient or owner.
- Thus the MA-MY PHR will highly reduce the key-management issues and overhead.

IX. CONCLUSION AND FUTURE WORK

In this paper, the issue of outsourcing of data in cloud is addressed by the method of key generation for cloud user. Cloud computing, besides providing a maximized effectiveness of shared resources, also provides an easy way of storing and retrieving data. Personal Health Records (PHRs) are designed to maintain lifelong details of patients. Automated Patient Identifier and Patient Care System is designed to count hospitalized patients based on the concept of Current Procedure Terminology (CPT) manager. Cloud storage service is accessed through the cloud computer service, web service application programming interface or by a cloud storage gateway. The cloud based workspace is centralized providing easy functionality to share. The cloud environment can provide improvements in system efficiency & density. As a part of future work, we have planned design the UML diagrams to look into the problem and to increase the clarity and to implement the uploading of encrypted medical data in cloud and in the process of creating individual cloudlets for preventing unauthorized user.

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