

Cloud Based Framework for Ethiopian Personal Health Record System

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Abstract— Cloud based Framework for Ethiopian Personal Health Record system is a proposed application, which creates, stores and manages patient medical records and allows access at anytime from anywhere through cloud computing. PHR is broadly considered as means by which an individual's personal health information can be collected, stored, and used for diverse health management purposes. It contains medication and treatment history that includes patients medical history, diagnosis, treatment plans, immunization data, allergies, radiology images, laboratory and test results. PHR can be managed, shared, and controlled by an individual or their care-givers and healthcare providers. The main intention of PHR is to have access to evidence-based tools that healthcare providers can use to make a decision and disease diagnosis about the patients care delivery. In this work we develop Personal Health Records (PHR) to integrate with the healthcare providers all over Ethiopia and to implement it with the cloud infrastructure. The main challenges that are addressed in this work are data storage, use of data analytics tool for decision making, data privacy, and the data security.

Keywords—Personal Health Record, Cloud Computing, Healthcare Provider, Patient, Medication History

I. INTRODUCTION

Information and communication technologies (ICTs) have a great role by enhancing access to health information and making health services more efficient and also contribute to improving the quality of services and reducing their cost in both developed and developing countries. PHR systems, for instance, have the flexibility to trace individual health issues and treatment over time, giving insight into best diagnosis and treatment of the individual moreover as rising the delivery of services by getting the appropriate personal information[1].

Ethiopia is one of the developing countries in the world. It has a total population of 102.37 million (2017) and more than 80% of the population lives in rural area, that means they are not easily accessing good healthcare center. The physician density shows in Ethiopia that 0.03 physician per 1,000 populations (2009). In 2018 also physician density shows 2.3 but still Ethiopian government tries to distribute healthcare centers in each rural area. So this proposed project helps for taking care of each individual in Ethiopia by recording their personal health status electronically and stored them on secure cloud based account for better accessing of health care center[2].

Cloud computing mentions to the distribution of scalable information technology resources over the internet, as

opposition hosting and operative those resources locally, appreciate on a business organization[3].

The main benefits of Cloud Computing are:

- Increase in computing power,
- Increase in storage capability and
- A high decrease in hardware cost.

Medical records are used for data mining techniques like classification, clustering and regression etc. Moreover, Machine Learning (ML) techniques can help in identifying the potential risk by discovering knowledge from medical reports of patient. Thus helps in preventing the disease progression[4].

Personal Health Record (PHR) allows creating, managing, controlling, storing and sharing an individual's personal health information in a private and confidential environment for diverse health management purposes. In some concepts, the PHR includes the patient's interface to a healthcare provider's like doctor and nurse electronic health record (EHR). In others, PHRs are any consumer/patient-managed health record which is patient-centric[5].

The foundation for public education efforts to highlight the benefits and risks of PHR will provide by this framework which aimed not only at an individual and patients but also at healthcare providers and other stakeholders. Because more of Ethiopian people are lived in a rural area there is limited internet access but in hospitals, there is an internet access. Today people need to monitor, track and evaluate their

individual health strategies as we are identifying an increased number of diseases and their cure. Those things are done by providing complete, updated and easily accessible health records; people can play a more active role in their healthcare as well as that of family members. PHR offers an instant simple affordable solution. PHR is a web-based application, which creates and manages individual health/ medical records and allows access at anytime from anywhere. And this proposed system store and access that personal health information is from the cloud.

Thus the organization of this paper is structured as follows. This Section presents the introduction and background of the study. In the second Section we have reviewed related works in the area, i.e. Personal Health record System. The third section contains detailed methodologies of the work. Results and discussions of the findings are presented in the fourth section. Finally, in the fifth and the last section we have discussed conclusion and future scope.

II. RELATED WORK

Mahammad Shafi *et al.* [5] proposed that Personal Health Record of an Individual in Ethiopia to creates and manages patient health/ medical records and allow access at anytime from anywhere. This study used basically for collecting and storing an individual's personal health information for diverse health management purposes. And this proposed system is an electronic record of an individual in Ethiopia, which provides identifiable health information that can be drawn from multiple sources. And the main limitation is that data storage, means data may be stored in different locations, including a provider's EHR, an Internet-accessible database, individual/ patient's home computer, a portable device.

R. Kavitha* *et al.* [6] proposed that Cloud based Electronic Health Record (EHR) for Indian Healthcare Needs and used for digitalize patients medical report and used for store the data in real time, it contains medication and treatment history which includes the broader view of patients care and it also contains patients medical history, diagnosis, medications, treatment plans, immunization data, allergies, radiology images, laboratory and test results. In their framework, the main intention is to develop Electronic Health Records (EHR) to integrate with the health care providers all over India and to implement it with the cloud infrastructure. Their main challenges that addressed in this works are, handling heterogeneous data, data storage, use of data analytics tool for decision making, data privacy, and the data security. The major advantage of this proposed system is once implemented it provides remote medication, vaccination management, disease diagnosis, remote diagnosis and remote real-time monitoring and personal health record.

Bizuayehu Getnet Demsash [7] proposed that Cloud Computing for Medical Image Archiving and Sharing for distribute and retrieve images across different healthcare providers and often requires the interaction of multiple

heterogeneous platforms. By doing thus, this analysis set out to verify the way to develop a framework that helps to supply a complete and timely access to vital imaging/diagnostic data at the purpose of care, regardless of the supply, age or location of the data in a cloud atmosphere and adopt cloud services, a style framework is developed so as to supply medical image archiving and sharing answer as a service. He came that "the analysis finding shows that Cloud Computing is a potential different the framework is beneficial to tending organizations for medical image archiving and sharing".

Alem Wassie [8] proposed that design and develop a prototype of electronic medical record system at the outpatient department of Yekatit 12 hospital medical college, Ethiopia. The study shows that health records are the most important database of the patient which consists of various data entered by healthcare professionals in either paper or electronic form. The proposed system uses Electronic-Health by the use of Information and Communication Technologies in health care. It is essentially involved with rising the flow of information, through electronic means to support the delivery of health services and the management of health systems. This system shows that in e-health applications Electronic Medical Record which is a computerized medical information system that collects, store and display patient information is one aspect. The record system provides comprehensive, reliable, relevant, accessible and timely patient information to each member of the health care.

Shruthi Suresh [9] proposed that Encryption Schemes for Securing Cloud-based PHR Systems to ensure privacy of health information, the best method is to encrypt it. In this study, Attribute Based Encryption and its variants are studied so that they can be used for developing an efficient health record sharing scheme which is more flexible and scalable. Health records are now stored and shared with the help of cloud services. The sensitive nature of these health records makes it vulnerable to attacks.

Welderufael Gebeyehu [10] proposed that Factors Affecting Access and Disclosure Practices of Personal Health Information in Public Hospitals, Addis Ababa, Ethiopia. This Personal health information (PHI) is individually identifiable health information about an individual or his family and relatives. And he said that this proposed study conducted in several countries demonstrate the importance of medical confidentiality for the privacy laws and policies concerning access and disclosure of PHI. Generally in this study, the majority of healthcare providers' in Ethiopia were erudite on the issue of personal health information, however, knowledge was not observed to influence their practice. Consequently, their attitude, reported work load, work experience, working schedule and availability of data clerk/statistician/ who support routine management of medical records were observed to influence their practice. Moreover, unavailability of local or national policy and its implementing guideline in all hospitals, make health care

providers and hospital administrators not to have clear and common understanding and uniform practice, especially, it was observed that hospital administrators have doubt how to work with other entities outside the health system.

Anteneh Aklilu[11] proposed that Need Assessment Framework for Electronic Health Record Management System in Ethiopia. The main objective of this study is to investigate the actual practice of patient's health record handling throughout the health institutions in Ethiopia and see the gap between the paper-based medical record and electronic health record and developing an architectural framework for an electronic health record. The result of the study disclosed that almost all health institutions are exercising paper-based health record handling and extremely few institutions are using technological devices to handle some part of their records. Architectural framework for an electronic medical record is a must to have to all health service providers in all levels in order to improve their performance and to provide up to the standard services to the community at large. The concerned management should provide the necessary attention to it. All health institutions should be ready to implement technology-based facility which is believed to be a must to have.

So, my work takes the gap that is not yet implemented the cloud-based PHR in Ethiopia and develop a cloud-based framework for Ethiopian PHR system. PHR system is faced with the necessity for prime process capabilities, giant storage capabilities, IT resource scalability and high accessibility, at rock bottom attainable price, cloud computing becomes a horny different. However, the nature of cloud computing creates challenges to an organization as they think about adopting it. problems admire security, legal and restrictive compliance become a lot of rife.

III. METHODOLOGY

To achieve the objectives of this study entitled with "CLOUD BASED FRAMEWORK FOR ETHIOPIAN PERSONAL HEALTH RECORD SYSTEM", the project was designed in an object-oriented view of system analysis and design methodology with incremental and iterative designing cycle. The requirements for the proposed system were collected through interview, observation and document review. Analysis and design of the proposed system were done using the unified modelling language by Microsoft Visio 2013. The following research methods are used in this proposed study:

➤ Literature Review

Different techniques and tools are used from previous works; many kinds of literature such as articles, books, and web sources are reviewed for detail understanding of this study.

➤ Interview

Different persons together with patients, researchers, doctors and ICT professionals from completely different care organization are going to be interview for a higher

understanding of this ICT utilization strategy, Effectiveness and potency of service delivery and their recommendations for higher service delivery can cowl by the interview.

➤ Tools

Different software's and planning tools are used. For implementation Open source Cloud Computing software's like an Open nebula, and different planning tools are used.

IV. RESULTS AND DISCUSSION

In the past, medical treatment suppliers have held on medical records of their patients on paper locally. This permitted a controlled atmosphere with the straightforward management of data privacy and security keeping the paper records in a cabin at the doctor's follow. Even the increasing use of desktop computers and trendy technology intending organizations allowed for an inexpensive effort to realize privacy and confidentiality of individual information.

This was owed to the decentralized and locally managed infrastructure of every tending organization. however, today outsourcing of IT infrastructure (e.g., cloud computing) and alternative services (e.g., billing process and accounting for medical practices) ends up in a posh system wherever privacy-sensitive information area unit hold on and processed at many various places. Hence, it becomes enticing to store and method tending information within the cloud (at outsourced information suppliers that may be accessed via the Internet). whereas such informatics systems promise improved service quality, the quality to manage information security and will increase privacy.

A. The Components of the Proposed Model

Cloud Control server: In a typical cloud, the cloud controller is in charge of managing physical resources, observance of the physical machines, keeping virtual machines, and assigning storage space. The controller reacts to new requests or changes in work by provisioning new virtual machines and assigning physical resources. This server additionally supports many ways that so as to facilitate higher management over the network as given below.

➤ The cloud central server takes network policy specifications (in addition to requests for VMs) and parses them to return up with a communication matrix for the tenant's resources. Associate in Nursing entry within the matrix indicates whether or not the virtual network between the supply and also the destination VM (row and column, respectively) ought to allow packets; if thus, whether or not layer two broadcasts is allowed, or layer three traffic is allowed, or each area unit allowed. And once layer three traffic is allowed, the entry additionally specifies information measure reservations and any middlebox traversal needed by traffic between the endpoints. The matrix is then passed to the network controller that interfaces with the programmable switches.

- It before inserting a VM on a physical host, the cloud controller consults the network controller to work out that hosts area unit candidates for putting the VM. The network controller utilizes a placement algorithmic rule designed to reduce the network state and maximize the performance and also the variety of virtual networks that may be supported within the cloud.
- It manages a software system programmable virtual put on every physical host that supports network services for tenant applications. The software system switch is organized to attach any variety of virtual machines to the physical network. The software system changes area unit essential for spreading network management outside the physical switches and into the destinations themselves.

Authentication Server: For the justification that within the application and information is placed on external of the organization within the cloud computing setting, the service supplier must use Authentication and Authorization procedure. Authentication implies that every user includes an individualism which might be confidential as real. this can be necessary as a result of some resources could also be licensed solely to bound users, or bound categories of users. Authentication is that the mechanism whereby systems could firmly determine their users. Authorization is that the mechanism by that a system determines what level of access a specific authenticated user need to go to secure resources controlled by the system.

- **Authorization:** Authorization implies that every resource - be it the spare computing power on a computer of a corporation or a group of astronomical information - can have a group of users and teams which will access it.
- **Resource Access:** Resource Access implies that remote resources are often accessible to Grid users. Such resources may mean all from computer processing unit time to disk storage, to imaging tools and information sets.
- **Resource Discovery:** Means those users will access remote resources via the web that they will use. Patient visits a tending Centre then a nurse documenting a visit of that patient. The PHR data support center supports associate interface that closely used the SOAP protocol for documenting a visit. SOAP is associate form comprising of the four stages involved;

Subjective that captures a patient's conditions in her own words,

Objective consisting of notes made up of measurements, physical examination, and tests,

Assessment consisting of an outline and medical diagnosis and at last

A plan that is that the care providers counselled a course of action that features prescriptions and referrals. As a part of the plan, the care supplier equally recommends, if he/she considers necessary, a follow up to be done by the tending employee. each visit documented by the nurse goes through

associate approval by a doctor. for each patient, the healthcare supplier will access the history of visits.

B. The implementation framework

Applying the Cloud Computing technology for the PHR database can give a lot of flexibilities and dynamic resource that resolves the scalability issues.

In this system there are three main entities such as a patient, doctor (nurse) and system administrator. All three entities have their own page with authentication. initial they ought to have to create an account before they use the system.

The user interface represents the interaction of system administration since it acts as Associate in a Nursing interface between the user and also the content of the clouds.

The programming layer includes three important elements:

- **The user portals:** user portals give the simplest way to access applications or internet services correct since all square measure situated on the online and might be retrieved victimization a web association.
- **Service catalog:** service catalog contains many varieties of services with information to access different information.
- **Repository service:** composed of various services like software package

SaaS layer: SaaS layer offers access to bestowed programs—applications or apparatuses on the Cloud.

PaaS layer: PaaS offers access to the variety of platforms—programming languages, net-centric systems, distributed systems, and platforms. The consumer will work with the virtual machine with some boundaries, and with this access, they will be managing a district of networking. Researchers and developers within the field of aid are used for his or her effort just by linking to cloud computing.

The **IaaS layer:** IaaS level provides a lot of resistance to the treatment of the material layer but by virtualization. Right now, we want to succeed in the idea wherever we have a tendency to train servers and configure their arrangements. in addition, the proposed framework has system security module for keeping the safety of the cloud, a service management module for dominant, programming and preparation of services and users log database module for following user's access to the cloud.

V. CONCLUSION AND FUTURE SCOPE

This paper represents the analysis, design, and implementation of the cloud based framework for Ethiopian Personal Health Record (PHR) and its recompense over the present PHR in Ethiopia. Cloud computing would facilitate PHR system to realize the economical use of their hardware and software reserves and to growth cost-effectiveness by refinement the use of resources to the acute. the aim of applying cloud computing systems in PHR is not to compete with one another, however, work to facilitate and develop the

standard of patient central information. By means of this performance we can support wellness activities by facilitating better and timely treatment by doctors. It will help the country's economy in technology sector to reach new heights. Cloud based PHR provides timely access to health profile of an individual for emergency case. And it can benefit individuals and their caregivers, healthcare providers, and societal/ population health benefits. In the proposed system all information related to the health profile of an individual is stored in cloud and accessed from the cloud. So, implementing this will be really helpful to the people who want their data for storing, accessing and managing inflexible way.

Through this Cloud based Ethiopian Personal Health Record system personal health-related data/information have been tried to be recorded, managed, organized and accessed through cloud computing. The deployment of the system on the cloud promotes flexibility, scalability and other advantages however there are some more additional tasks to be addressed and others to be handled extensively as it has been learned from related systems or products being used in other countries. These include the following:

- Integrate with more security mechanism for sensitive patient health record data on the cloud
- Designing and implementing mobile computing based personal health record system
- Integrating this cloud based Ethiopian personal health record system with the expert system to diagnose the disease of the patient and given prescription accordingly.

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