Impact of Internet of Things to Health Institutions in Clinical Data Management

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Abstract- Internet of Things (IoT) is the internetworking of physical devices, which consists of an embedded system with sensors, actuators and network connectivity that enable collection and exchange of data. On daily basis there is emergence of new technologies that have the capability to embed into our environment and measure the physical, social and contextual phenomena". The technology behind IoT is driven by various technological innovations such as smart devices, wireless network, and pervasive connectivity among others. Data collection, management and accessibility are made easy with Internet of Things IoT. IOT is aimed at formulating a complex information system with the combination of sensor data acquisition, efficient data exchange through networking, machine learning, artificial intelligence, big data, and clouds. This paper therefore focuses on the impact of IOT to clinical data management in health institutions. This includes the impact on how data are collected, how they were being analyzed and stored, its impact in terms of security and privacy related issues.

Keywords—*Internet of Things, Clinical Data, Security, Privacy and Big Data*

INTRODUCTION

Internet of Things (IoT) technology seems to have become part of our daily lives of which health institutions is not left out. In hospital emergency wards, the severity of tasks posed serious health risks to patients. Patient management when achieved through conventional methods can lead generally to management breakdowns resulting to degradation in the performance of efficient management approaches. Hence, many healthcare institutions in Nigeria suffer from a plethora of inefficiencies and dysfunctionalities. Though government and individuals are putting much effort into new hospitals, rehabilitations of old ones, training of new physicians among other things, but the problem still persists and medical staff, patients and globally health system are severely affected. Because of the aforementioned, this study is carried out to consider the impact of IoT to health institutions in clinical data management and as such variables that are principally linked to mismanagement of health-related activities, equipment, human and material resources will be reveal. The numerous studies that have been carried on this issue have almost shown the importance of management and management breakdowns among the medical staff members that inevitably have an impact on the quality of care provided to patients and put them in a potentially vulnerable and dangerous situation (Sabooniha, Toohey & Lee, 2012).

In this paper, there is need to consider the Governance, Risk and Compliance approach (GRC) coupled with Internet of Things technology (IoT) called tGRC. This study is done to help provide a set of tools that may effectively address core medical needs and improve the

quality of patients' care. One can propose an effective support enabling management features of the related tasks as well as providing an efficient data collection in real time awareness around the occurring events; particularly those, which constitute a priority in any health institution. For instance, one can begin by analyzing the way with which medical staff collect information, operate with different medical scenarios, and how they manage the work. It might be evident that the medical staffs are suffering under the load of all the procedural, intellectual and social complexity of the management process. Indeed, the heavily accumulated volume of data ought to be collected, processed and made available for appropriate use.

Literature Review

According to Ovidiu and Peter (2013) IOT can be referred to the general idea of things, mostly everyday objects, which can be readable, recognizable, locatable and addressable through information sensing device and control through the Internet regardless of the means of communication. Internet of Things (IoT) is an extension of the Internet where large numbers of "things" such as sensors, actuators and processors, including human users, are networked and able to provide high resolution data on their environment and exercise a degree of control over it (Peter & Richard, 2017).

DOMAIN MODEL FOR HEALTH INSTITUTION APPLICATION BASED ON IOT

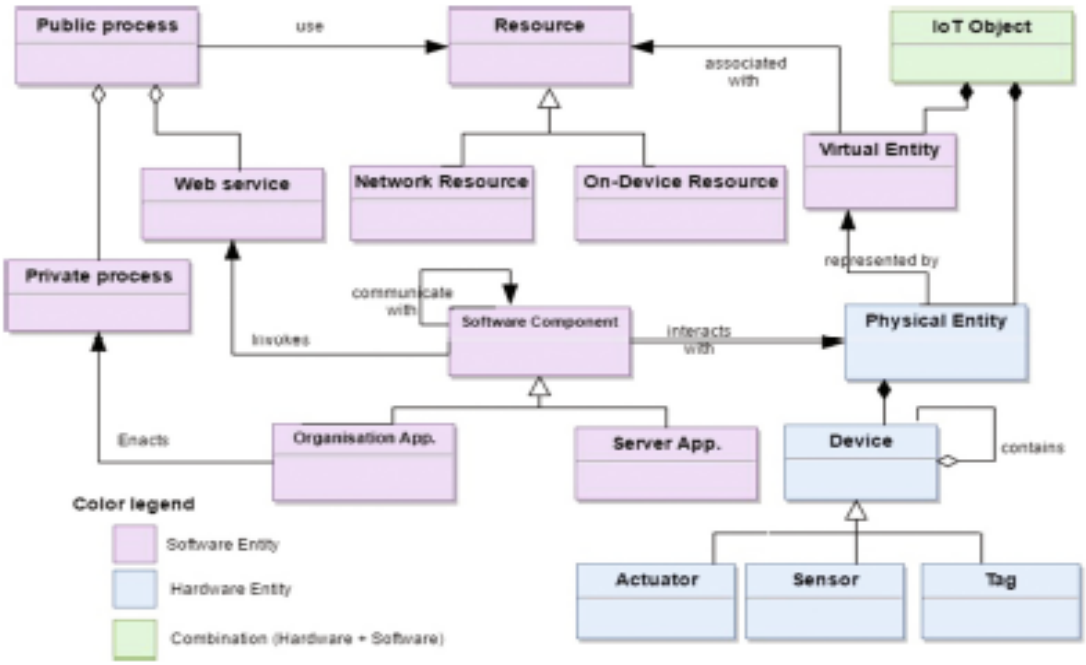

Fig. 1. Domain model of health institution application based on IoT

Fig. 1 is a conceptual model for a health institution application based on IoT. The model is founded on advanced enterprise systems (Benmerzoug, 2015) and those of the IoT domain (Haller, Serbanati, Bauer & Carrez, 2013). As seen in the above diagram, it is composed of domain entities and shows the interrelating pathways that can exist between those entities.

Clinical Data Management

It is quite obvious that the amount of data generated in a hospital is voluminous as its information though sometimes proving unnecessary but still much valued in forecasting,

drawing a correlation and regression as well as real time monitoring. Hence, in order to effectively and efficiently use this information, all processes will require rigorous execution for a better result. The following is imperative:

Quality Assurance (QA) these processes ensuring that the clinical data presented and interpreted in the clinical study report reflect a true picture of what took place in the trial.

Quality Control (QC) based on the definition in the ICH GCP definitional guidelines for QC is the operational techniques and activities undertaken within the quality assurance system to verify the requirements for quality of the trial-related activities have been fulfilled (Benmerzoug, 2015).

Audit is a systematic and independent examination of trial related activities and documents to determine whether the evaluated trial related activities were conducted and accurately reported according to the protocol, sponsor's standard operating procedures (SOPs), GCP, and the applicable regulatory requirement(s) (Benmerzoug, 2015).

Performance defines a measure of fitness for purpose and can be used as an overall measure of quality and productivity or work rate. In performance, a *standardized* set of process tasks must be clearly defined.

DEFINING THE PROCESS FLOW

A summary of key data management tasks is presented below and will be used as a focus for performance measurement:

- *Data collection*: Data can arrive in an electronic format, such as laboratory data from central laboratories, diary card data collected on hand-held computers or via interactive voice response systems, or more directly via remote data entry systems and remote data capture solutions.
- *Pre-entry data review* (secondary monitoring). Often, a pre-entry manual review of all source CRF data is made to ensure completeness of data. Some data may be coded at this stage to support the data entry process. Data queries may also be raised at this stage.
- *Data entry.* Following receipt of data from the investigator site, data are keyed or loaded into the clinical database.
- *Data validation.* Data are cleaned in a batch process using validation programs which have been specified and developed before data entry commences. The majority of data queries are generated at this stage.
- *Term coding.* Adverse event data, concurrent medications and medical conditions are often coded using standard dictionaries both using an auto encoder and via manual coding. Again, this is often a batch process.
- *Database editing.* The developing database is edited following batch receipt of resolved data queries from the field.

Process tasks listed above are by no means comprehensive but typically summarize the in-process flow for data management

The Proposed Information System Architecture Based on IOT Technologies

Specific sensors are used to collect comprehensive physiological information and uses gateways to send data to the server on the cloud for analyzing and storage. Information is sent afterward to medical-staff wirelessly. Our proposition is shown in the figure below

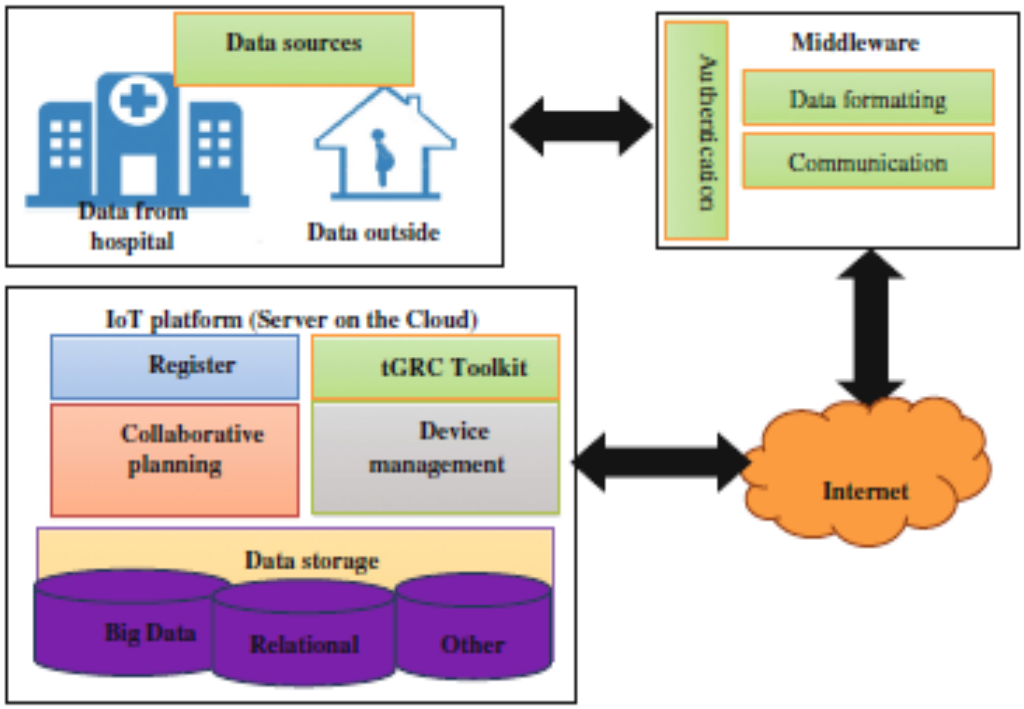

Fig 2 A Proposed Structure

For data collection, the use of IoT solutions greatly improves the quality of care through continuous attention and lowers the cost of care by eliminating the need for a medical-staff to actively engage in data collection. In addition, the technology can be used for remote monitoring using small, wireless solutions connected to patients through the IoT capabilities.

Data collected from different sources like wearable devices or from sensors (installed on different equipment) are so big that it becomes big data. Big data powers the IoT, and as data connectivity evolves into 5G networks, Wi-Fi capabilities expand, and smartphone users grow even larger in population, the "big" in big data grows even bigger. Big data and IoT devices have a symbiotic relationship, and if there's an AI system responsible for processing that data and making decisions, then that adds another variable to the equation. As big data storage is both the repository and source of data, the more IoT devices that get connected, the greater the spotlight on big data hardware. Performance and processing depend on the capacity of the big data hardware to pull what is necessary, which highlights the importance of investing smartly in efficient hardware and optimized infrastructure design.

Importance of IOT in health management

From all indications, it will not be out of place to state here that the important of IoT is to connect smart objects (which is things) to the Internet in a transparent way thereby leading to an exchange of data between all things, and bring health users information in a more secure way.

Challenges associated with the use of IoT.

One major challenge in Nigeria over the years is the issue of security which networks is not excluded. Therefore, security, privacy and trust are critical factors for IoT applications as well. IoT devices are low power constrained devices, therefore, already established cryptographic solutions cannot be directly applied in the IoT scene.

There were warning from cybersecurity experts on IoT as the most vulnerable technology as they expect more targeted attacks on existing and emerging infrastructures such as data theft, physical injury, ransom-ware for smart homes or smart cars among others.

Data Privacy is to protect data from exposure in the IoT environment. For instance, any logical or physical entity can be given a unique address and the ability to communicate automatically over the network.

CONCLUSION

Clinical data managed over IoT platforms are easily accessible over the internet and can be collected from different clinical institutes. The biggest challenge from the regulatory perspective would be the standardization of data management process across institutes, and development of regulations to define the procedures to be followed and the data standards. From security perspective, the biggest hurdle would be the planning and implementation of highly secured infrastructure that will protect the clinical data from hackers.

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