Importance of Cloud Computing and Internet of things in Healthcare Systems

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***Abstract*-Cloud computing can be defined as the high demand presence of the computer technology, mainly for storing the data, for calculating the power, shorn of for unswerving data management by the operator. Cloud computing can be commonly defined as the storage stock for data of uncountable number of users of the technology services.**

The Internet of things (IOT) is an interconnected computing device. It interconnected different types of machine and objects like mechanical, digital, human etc. It provides the unique identifier (UID) and functionality to transfer data on internet without human interaction.

Cloud computing is an emerging field in computer science. It is designed to deliver number of computing services via networked such as web.

The internet of things has made it possible for-off the nursing of patients on the quick access in the healthcare stream by consuming the less amount of time, unchecking the potential for the safety of the patients regarding their health, and also encouraging the specialists to give the best level of treatment for the patients. Due to IOT the communication between the patients and doctors have become quite easy and in less amount of time. As a result, the satisfaction level of the patients has increased and the solution for patient's problem has also become easily available. Due to IOT the costs in healthcare systems have become significant along with the outstanding results.

IOT is undoubtedly transforming the healthcare industry by redefining the space of devices and people interaction in delivering healthcare solutions.

In this paper author introduce the idea of cloud computing and internet of things in healthcare and its scope. IoT application is mainly used in healthcare by the hospital and insurance companies for the assistance of patients.

Keywords: Cloud computing in health care system, iot in healthcare system, advantages and disadvantages in healthcare system, future scope, present condition, applications.

I. INTRODUCTION

Here in this report the applications and various embedded features of cloud computing and internet of things in health care system are mentioned. IOT is the connecting link between the physical objects that consist an electronic feature develop within it which in sense helps the people to increase the communication between specialists and patients and also with references to the present and the developing infrastructure of the society. As per the analysis between todays condition of healthcare system and the future one the approaching era would be quite well developed and systematic then the present one. As a result, the treatment given to the patients would also be at the best level and the condition of the patient would be better and would also receive more convenient treatment due to IOT in healthcare systems. With the help of IOT the advancements would be able to notice in the medicines, the gene therapies, the surgeries and in many other contents in healthcare sector.

In the term of cloud computing the word 'cloud' can be defined as the symbol of internet. In the past decades we needed the computer server at specific location only to operate our applications and software's. But today with the help of internet and overview to cloud computing we can access our applications anywhere and at any time. Not only for accessing purpose but also for storing data it is very useful. As a result, in the field of medical also the use of cloud computing is at high range. It is used by the specialists for surgery purpose for therapy, operations, etc. With the help of cloud computing the internal structure of body could be display in easy manner and which helps the doctors to do their task more specifically and appropriately. Many of the companies are using cloud computing for their operation and as per the study the level of healthcare sector would also be increased in upcoming days.

There are two ways of building IOT:

1. Form a separate internetwork including only physical objects.[1]

2. Make the Internet ever more expansive, but this requires hard-core technologies such as rigorous cloud computing and rapid big data storage (expensive). [1]

II. CLOUD & HEALTH CARE

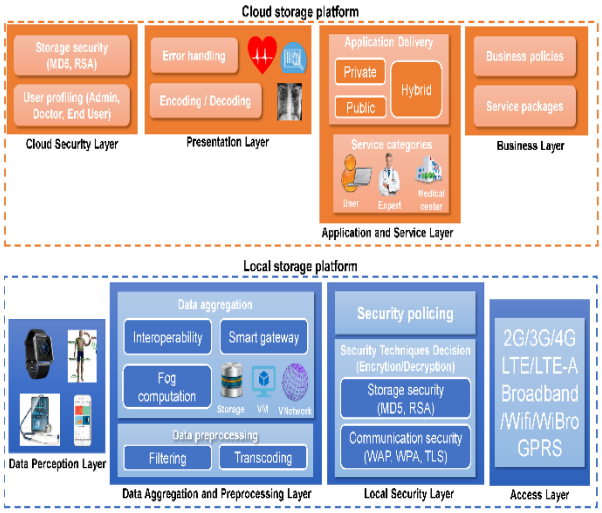

Figure 1: Common IOT HEF platform including local storage and cloud storage platforms

The acceptance of the cloud technology is spreading at an exponential pace. The driving force behind the widespread of cloud technology mainly comprises of its cost effectiveness and multiple benefits which comes with its use. For the best healthcare organizations cloud computing provides a quick and beneficial level of service as compare to the interior efforts provided. Some phase of this(medical services) has to been done in particular range or level but for rather phases it requires the strong financial support , high technology ,strong processors and the experts which a cloud providers can bring to healthcare sector by its various communicating applications, high developed software's and also by the ideological thoughts spread through worldwide web.

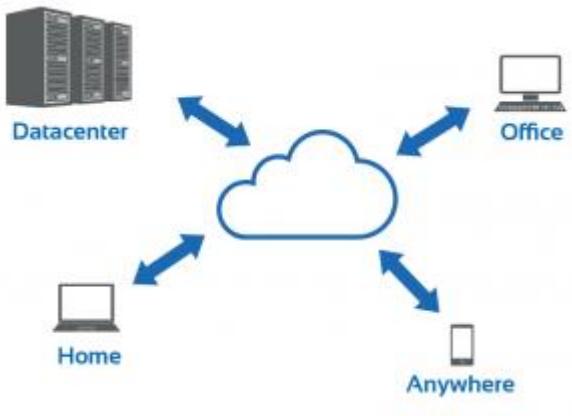

Figure 2: cloud Data

III. Main Application of IoT in medical field

In the hospitals and also in various other field of health sector the main challenge faced is the storing of medical data, at the most for X-ray, images and other related pictorial data. At the date many of the Healthcare locations are having their own Picture Archival and Communication Systems (PACS) due to this they are archiving the records related to any of patient. As it is beneficial but it also consists of one drawback namely the high cost for storage, it goes up to billions of terabytes of the records. As the solution for this issue have also been discovered that is the cloud which provides storage-as-a-service. As a result, many of the specialists can see the x-ray of their patient at any of the location via INTERNET.

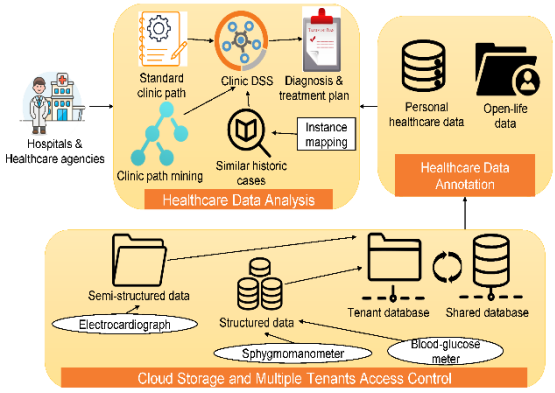

Figure 3: Functional Platform of Cloud Computing

There has been a lot riding on the cloud and both Microsoft and Google are investing heavily in the technology [2]. But technology for the sake of it and without any specific implications is going to be counterproductive in the healthcare Industry. The two examples mentioned are just a minute part

which has been utilized but for sure in the upcoming duration there would be more sectors in healthcare would access this (cloud) in the healthcare. The main motive of healthcare organizations is to provide a proper care, high technology in short, the business for the betterment of the people.

Rather than offering the cloud as a cover to just earn money in healthcare industry they should provide a time to spend of its beneficial part which can help to develop the healthcare system and should offer in that manner or else the cloud accessing level would be low only in the healthcare sector as compare to other service sectors.

IV. USE OF IOT IN HEALTHCARE SECTOR

A. IOT for Patients

Devices in the form of wearables like fitness bands and other wirelessly connected devices like blood pressure and heart rate monitoring cuffs, glucometer etc. give patients access to modified attention. These devices can be tuned to remind calorie count, exercise check, blood pressure variations, heartbeat rate and much more.

IOT has changed the lifestyle of the people's especially elderly ones; it provides the quick respond to their problems and to be solving them in convenient duration. With the help of IOT if there occurs any of mis-match to the regular health treatment then an alert mechanism is been delivered to the family members and also to the health providers due to which the situation could be taken under cover easily and also by saving the time.

B. IOT for Physicians

With the help of the various equipment's mentioned by the IOT such as home monitoring and other wearable devices it has become easy to the physicians to handle their patient more easily and conveniently. The patient's loyalty can be seen by the physicians regarding their treatment any if any sudden help require could be submitted in easy and simple manner. Due to IOT it has made the specialist to be more careful and to be in contact with their patients and to keep them always active regarding their health and services. The collection done by the IOT appliances made it easier to the physicians to study the patient's problem and to give them the best treatment to receive the best result in the patients' health.

C. IOT for Hospitals

Rather than monitoring patients' health, there are many other areas where IOT devices are very useful in hospitals. IOT devices attached with sensors which are used for tracking real time location of medical equipment like wheelchairs, defibrillators, nebulizers, oxygen pumps and other monitoring equipment.[1] Efficiency of medical staff at different locations can also be analysed at the time.

The spread of infections is a major issue for patients in hospitals. IOT-enabled hygiene monitoring devices help in preventing patients from getting infected. IOT devices also help in asset management like pharmacy inventory control, and environmental monitoring, for instance, checking refrigerator temperature, and humidity and temperature control [1].

D. IOT for Health Insurance Companies

The various types of chances are given and operated by the health insurers e.g. IOT connected intelligence devices. Insurance companies can influence data captured through health monitoring devices for their underwriting and claims operations.[1] This data will enable them to detect fraud claims and identify prospects for copywriting. IOT devices bring direct connectivity between insurers and customers in the underwriting, pricing, claims handling, and risk assessment processes. In the light of IOT-captured data-driven decisions in all operation processes, customers will have appropriate visibility into underlying thought behind every decision made and process outcomes.

The insurers might offer the reward for the customers for using the IOT appliances to keep their regular activities on the right track and to follow all healthcare treatments properly. Due to which the claims of the insurers get reduce easily and significantly. Due to the information stored by the insurers with the help of IOT helps the company to increase their claims.

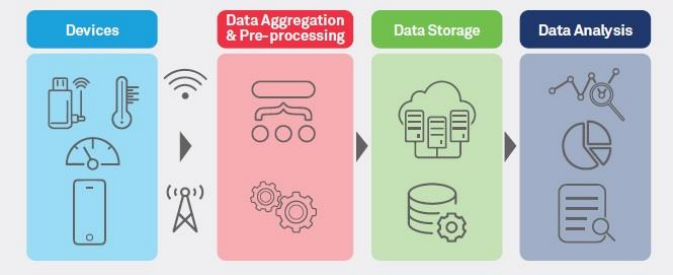

Figure 4: Format of Data Science

V. USE OF IOT IN HEALTHCARE SECTOR

The production of healthcare-specific IOT products opens up huge opportunities. And the large amount of data generated by these connected devices holds the potential to transform healthcare.

IOT has a four-step architecture that is basically stages in a process. All four stages are interconnected in a manner that data is captured or processed at one stage and yield the value to

the next stage. Innovative values in this process bring solutions and deliver outstanding business aspects.

Step 1: First step consists of deployment of interconnected devices that includes sensors, actuators, monitors, detectors, camera systems etc. These devices collect the data.
Step 2: Usually, data received from sensors and other devices are in analogue form, which need to be aggregated and converted to the digital form for further data processing.
Step 3: Once the data is digitized and aggregated, this is pre-processed, standardized and moved to the data centre or Cloud.
Step 4: Final data is managed and analysed at the required level. Advanced Analytics, applied to this data, brings actionable business insights for effective decision-making.[1]

IoT is redefining healthcare by giving better care, modified treatment results and reduced costs for patients, and better processes and workflows, improved performance of the specialists and patient experience for healthcare.
The major advantages of IoT in healthcare consist of as follows points:

- Price Reduction: IOT provides patient monitoring in real time, thus significantly cutting down unnecessary visits to doctors, hospital stays and re-admissions
- Modified Treatment: It enables physicians to make evidence-based informed decisions and brings absolute change in the patients' health.
- Faster Disease Solutions: Regular patient monitoring and real time data helps in diagnosing and curing the diseases at an early stage or even before the disease develops based on symptoms occurring in the patients' health.
- Active Treatment: Continuous health monitoring opens the doors for providing proactive or positive medical treatment.
- Drugs and Equipment Management: Management of drugs and medical equipment is a major challenge in a healthcare industry. Through connected devices, these are managed and utilized efficiently with reduced costs.[4]
- Error Reduction: Due to the data generated through IOT devices it not only helps in effective decision making but also provide smooth healthcare operations with reduced errors, waste and system costs

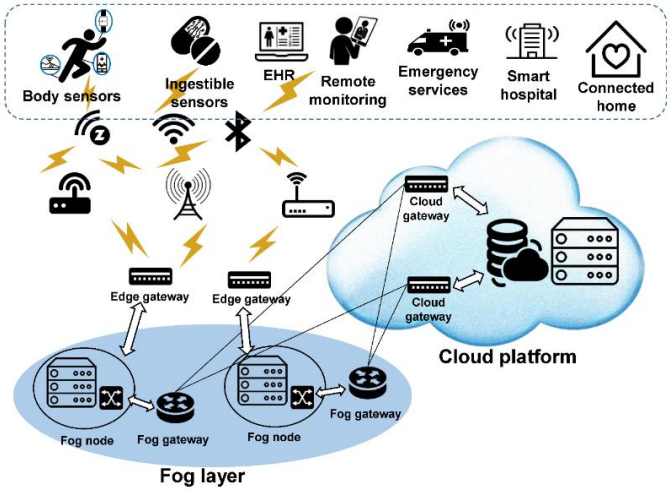

Figure 5: Cloud Computing Platform

VI. FUTURE SCOPES OF IOT IN HEALTHCARE

A. *Remote Monitoring*

Customized software and devices will read data from medical cards of patients in real time and help doctors in conducting a better analysis of patient's health [4].

B. *Wearables*

Different gadgets that can regularly monitor for daily activities of the patients and store the data that is available in the market. These devices inform patients about their physical activities. They can also help in preventing emergency, as patient's information would be sent to the doctor immediately [4].

C. *High Quality Monitoring*

Due to an IOT can help in providing functions and controllers to various important equipment in the hospital. As the equipment are critical while treatment, any defect in them can be fatal. Connecting these devices will enable the staff to monitor their working easily. Defects in the devices can also be figured out in real time; thus, reducing the chances of improper treatment [4].

VII. FUTURE BENEFITS OF IOT IN HEALTHCARE

A. *Better Supervision and Reporting*

Real-time supervision through IOT devices can save lives in medical emergencies such as asthma attacks, heart failures etc. [4]. The connected device can collect important data on patient's health and transfer it to the physician in real time. A study conducted by Centre for Connected Health policy

suggests that there was a 50% reduction in re-admission rate of patients due to remote supervision [4].

B. End-to-End Connectivity

IOT can operate the workflow of patient care with the help of healthcare mobility solutions. It provides interoperability, machine-to-machine communication, and data movement and information exchange while making healthcare delivery more productive. Different connectivity software's or functions in the devices allow hospital personnel to spot early signs of illness in the patients.

C. Data Analysis

IOT devices can collect report and analyses the extensive data collected in short time, deleting the need of its storage. Which would allow healthcare providers in focusing on exact data required to treat the patient? Due to this data driven signs it would speed up and make it easy for the doctors to do the decision-making task for their patient.

D. Alerts and Tracking

Timely alerts can be critical in case of life-threatening circumstances. IOT allows medical devices to gather essential data and transfer it to doctors in real time. The reports provide perfect opinion on the patient's condition, irrespective of location or time [4].

E. Lower Costs

The connected devices and wearables will allow patients to connect with doctors from their homes. The regular visit for different tests and check-ups will be minimized. This will save cost and time of patients on a daily basis.

F. Medication Management

With the help of smart wireless pill bottles, tracking medication schedule will become easy. This will help people who forget to take their medications on time. The IOT enabled medication management processes will also provide doctors with analytics for offering better care to the patients.[4]

VIII. FUTURE CHALLENGES OF IOT IN HEALTHCARE

Healthcare IOT is not without challenges. IOT-enabled connected devices capture huge amounts of data, including sensitive information, giving rise to concerns about data security.

IOT explores new dimensions of patient care through real-time health monitoring and access to patients' health data. This data is a goldmine for healthcare stakeholders to improve patient's health and experiences while making revenue opportunities and improving healthcare operations.

With the increase in the market for healthcare IOT, the challenges are bound to increase. Unauthorized access to connected devices can cause harm to the patient's safety. Thus, proper authentication and authorization will be necessary to achieve success with IOT.

CONCLUSION

The cloud computing and IOT play an important role in healthcare system by performing the business of care for the peoples. By using IOT in Health care the treatment level would be best and also convenient to patients as well as to the doctors.

As per the today's condition of the healthcare it could be more developed by increasing the use of cloud in it. Likewise, in other fields the medical field too can utilize the cloud in it and can modify and invent new technologies for the best care and service of the peoples.

If the proper use is done of IOT in medical sector then it can take the medical sector to the top level along with best results and innovative technologies.

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