

Optimization and Control of Medical Industry Resources using Internet of Things

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Abstract—IoT is finding applications in diversified fields, including healthcare industry. The paper presents how IoT is changing healthcare industry into IT based healthcare system. IoT in health industry contributes to physical devices like blood pressure, glucose, heart rate monitoring etc , these devices communicate over internet and transforms the physical world data into digital world. The smart devices having internet access and are increasing rapidly over the past decade, it is proposed that by 2020 the figure would reach 26 billion. These devices can be used to share and gather information over the cloud that will help in analysing and recoding patient health data remotely. The information collected by these devices provides facts related to patient health and medicinal side-effects, without effecting patients daily routine. This paper outlines the role of IoT devices in health care sector as well as the role of information technology in managing the large volume of patient's medical data. Further the paper also discuss the challenges in real word regarding implementation of IoT in healthcare industry a generic IoT architecture in health industry is also presented.

Keywords: IoT, eHealth, m-Health, Healthcare industry

1. INTRODUCTION

Internet of Things is a future technology, it has a great potential to change the every aspect of health care industry. Internet of Things also called as a network of smart devices which communicated with each other over internet. These devices has in-build sensors and actuators to interact with real world. The internet of things is a technology which allows devices and people to be connected with each other at any time, any place, anyone and anything. The main growth in IoT[1] sector is due to large increase in number of smart phone and tables. These devices act like a window for IoT-world. These devices are capable of performing the wide range of tasks both for doctors and patients without interrupting their daily schedule due to their connectivity and mobility features. Increase in number of device in IoT will increases data generation, so we need more space to store the data because of this we use cloud computing. After storing the data on cloud, we use the complex data analysing technique which providenecessary information to both doctor and patient.

There are four basic steps in every IoT [2] based health care system:-

- (i) Collection of patient data through sensors.
- (ii) Analysis and processing of data through microcontroller on the device.
- (iii) Information about data through graphical user interface.
- (iv) Transfer the data over cloud storage through gateway for further analysis and future reference.

In IoT, devices are directly connected to each other. To share and capture data over a Secure Service Layer , a Central Command Server in the cloud is needed. Before IoT, internet dependents on humans for data collection which generate the problem like time limitation and accuracy, it means that information over internet is not very good or accurate. To remove these problems , remains a big challenge.[3]. Advancement in communication technology and sensors allows devices to record, collect and analyse data. In case of health industry, it requires collection of patient data that will be helpful in preventive care, promote diagnosis and also in understanding patients body parameters. The property of gathering data on its own using IoT devices, remove the limitation of human error, because of which health industry can increases the efficiency of their service, lower price of service and also increases quality of services.

2. INTERNET OF THINGS-VISION

Internet of things is still in its early stages, everyone interprets the vision of IoT in their own manner [4]. There are main 3 vision of IoT.

- (a) Things based vision- In this vision we assume the all and every real world objects have sensors to collect real time data form them and their environment. This is only possible if every object have an in-build embedded system which read and communicate data collected by their sensors.

(b) Internet based vision- In this vision we assume that all the devices are connected to each other through internet and behave like smart object. This is only possible if every object connected over internet using their unique IP. This vision is also known as data integration.

(c) Semantic based vision- Data collected by various sensors are processed and analyzed to generate a meaningful interpretation.

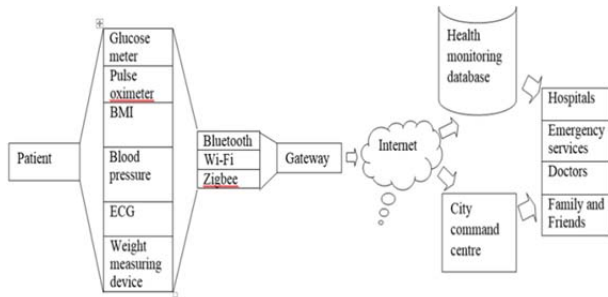


Fig. 1: Generic architecture of IoT based health care services.

3. ARCHITECTURE OF IOT BASED HEALTHCARE-SERVICES

In the proposed architecture of the IoT- Health services, medical sensing devices like glucose meter, pulse oximeter, BMI, blood pressure monitor, ECG and weight measuring devices are wirelessly connected to the gateway through the technologies like Bluetooth, zigbee, Wi-Fi. This wireless facility allows patient to use medical devices anywhere in his home and office, it also provides freedom of mobility. These medical devices continuously monitor and record the patient body parameters and side by side transmit their data to gateway through wireless facility, they have embedded WI -Fi facility.

Gateway basically a middle device is used to convert the data format, so that data can be easily transmitted over the internet. Cloud network is used to connect Health Monitoring Database Centre, City Command Centre and Gateway. Health Monitoring Database is used to store patients data, while City Command Centre generate an alert signal in case of any emergency. In case of emergency situation City Command Centre contacts the nearest hospital and emergency services for providing the assistance to the patient. While Health Monitoring Database is connected to every hospital so that they can access patient health record for consultation.

4. IOT CHALLENGES IN HEALTH CARE

IoT faces challenges in various areas like technical, marketing, regulatory and socio-ethics. But our main focus is on the privacy factor, which causes other challenges like government participation. Many of the IoT challenges can be easy resolved by integrating efforts of society, private sector and government sector.

5. SCALABILITY-

Over a billion devices can be connected on an IoT network which causes the problems like data handling and data processing [5]. So, the systems used to store and analyse that data should be scalable. IoT connects people and everyday objects with each other, data generated by these devices needs a big data analyser and cloud storage which will convert them into a meaningful information.

6. HETEROGENEITY-

Technological standards are not been set in IoT. That is why we need to converge the technologies on the same standards, to create a common framework [6] for IoT devices. The lack in interoperability in IoT is preventing us to achieve the goal of truly connected Smart IoT network.

7. ABSENCE OF GOVERNMENT SUPPORT-

Regulatory bodies of government should play an active role in IoT development, for setting up the standards for IoT devices and for security and safety of public.

8. PATIENT'S SAFETY-

Most of the IoT nodes are left untouched since they are placed in the real world. IoT nodes for medical patients are of two type 1) Implanted and 2) Wearable; They can be selected depending on the purpose of the device. Any breach in security of these devices may cost patient life.

9. DESIGN CHALLENGES-

IoT devices has limitation of energy supply, because most of them works on batteries. These devices also have the problem of limited memory and computational power which may get resolved in future depending upon improvements in the technology.

10. IOT TRENDS IN HEALTH CARE

Smartphones currently being used can support health-sensors-accessories like Wrist Health Monitor. In m-health service we use mobile and wireless devices to evaluate patient health and consult medicines. These devices also reduce the medical errors, due to there continues monitoring feature. IoT application in Heath industry basically grouped in following categories according to their functionality.

1. People and object tracking.
2. Data sensing and collection
3. Tele-medicine

Medical data received from wireless devices play a very important role in managing and preventing chronic diseases and can also be used for monitoring of patients after they get discharge from hospitals. There are many wearable devices

available these days like ECG monitoring [9], pulse oximetry, glucose monitor and blood pressure monitor.

11. WIRELESS PATIENT MONITORING-

Application of IoT in healthcare, include remote monitoring of patients parameters by using internal and external medical devices. they collect data from patient body to share it with experts in real time. This is particularly important in the case of chronic disease management like diabetes, hypertension, asthma etc. Some of the examples of these devices are pacemakers and automatic defibrillators.

12. MOBILE SYSTEM CONTROL (E-HEALTH)-

Mobile technologies can be used to remotely access and control the clinical systems like electronic health records, PACS [7] etc. Almost every medical instrument/ machine can be easily controlled and operated by using mobile application interface. This technology is called e-Health technology.

13. IOT BASED MEDICAL DEVICES-

Capturing and tracking the patient compliance and disease data can be done with help .Smart diagnostic devices are used to track patient activities and capture the data from patient body using sensors for the future analysis [8]. Examples of these devices are digital glucometer, pedometer [10], wearable fitbits, google glass etc.

14. TELEMEDICINE

In this application, remote connectivity and multimedia technologies are used to provide virtual health consultation and medicines advice. Telemedicine is one of the important and emerging fields in medical science [11]. Using telemedicine services, the medical consultation in the remote and rural areas becomes possible.

15. CONCLUSION

All the physical objects currently, works with human to machine or machine to machine interface. Their degree of interconnection is like boons for the healthcare industry, through IoT devices we can analyse the internal and external factors of human body. These factors also help us to predict the allergies and health trends for the person. Therefore, by using the present technology customized recommendation can be provided on patient physical activities like diets, heart rate, blood pressure etc. Basic architecture of the IoT in the health care service can be implemented that will ease out diversified processes in the health care industry with the IoT network. IoT will introduce a new delivery method in medical and Health industry which will improve the quality of services and lower the cost of these services. IoT provides the freedom in health care by connecting health devices remotely for detection of different infections.

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