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Application of Internet of Things in the Field of Medical and Smart Health Care

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ABSTRACT: IOT basically comprises of physical articles that are installed with sensors, actuators, processing gadgets and information correspondence abilities. These are connected to systems for information transportation. Envision a situation where patient's restorative profile, indispensable parameters, and dialysis machine info are caught with the assistance of medicinal gadgets connected to his body. The patient does not need to move from office to office to get treatment. Or maybe, he can complete his dialysis the assistance of a versatile home machine intended for the reason. Information assembled from this gadget is broke down and put away, and the accumulation from different sensors and restorative gadgets settles on educated choices in convenient way. Parental figures can screen the patient from any area and react properly, in light of the caution got. Propelled treatment of this nature can radically enhance a patient's personal satisfaction. The current headways in innovation and the accessibility of the Web make it conceivable to interface different gadgets that can speak with each other and share information. The Web of Things (IoT) is another idea that permits clients to interface different sensors and savvy gadgets to gather continuous information from nature. The model named as 'k-Social insurance' makes utilization of 4 layers; the sensor layer, the system layer, the Web layer and the administrations layer. All layers collaborate with each other viably and proficiently to give a stage to getting to patients' wellbeing information utilizing advanced mobile phones. The quick development of electronic gadgets, advanced mobile phones and tablets which can be imparted physically or remotely has turned into the principal device of day by day life. The up and coming era of associated world is Web of Things (IoT) which interfaces gadgets, sensors, machines, vehicles and other "things".

KEYWORDS: RFID, IPv6, Cloud computing

I. INTRODUCTION

In the new era of communication and technology, the explosive growth of electronic devices, smart phones and tablets which can be communicated physically or wirelessly has become the fundamental tool of daily life. The next generation of connected world is Internet of Things (IOT) which connects devices, sensors, appliances, vehicles and other "things".

"If we had computers that knew everything there was to know about things using data they gathered without any help from us we would be able to track and count everything, and greatly reduce waste, loss and cost. We would know when things needed replacing, repairing or recalling, and whether they were fresh or past their best. We need to empower computers with their own means of gathering information, so they can see, hear and smell the world for themselves, in all its random glory. RFID and sensor technology enable computers to observe identify and understand the world without the limitations of human-entered data."At the time, this vision required major technology improvements [M. Kärkkäinen and J. Holmström 2002]. After all, how would we connect everything on the planet? What type of wireless communications could be built into devices? What changes would need to be made to the existing Internet infrastructure to support billions of new devices communicating? What would power these devices?

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What must be developed to make the solutions cost effective? There were more questions than answers to the IOT concepts in 1999.

IOT describes a system where items in the physical world, and sensors within or attached to these items, are connected to the Internet via wireless and wired Internet connections. These sensors can use various types of local area connections such as RFID, NFC, Wi-Fi, Bluetooth, and Zigbee. Sensors can also have wide area connectivity such as GSM, GPRS, 3G, and LTE.

- IOT basically connects different objects (sensors) to each other. Through connecting medium which can be wireless or wired. When object can be sensed then we can be perform action according to that. And that is known as smart objects.
- Basically IOT made day to day life easy and we can do things automatically with using IOT technology. It includes many field like home automation, health care, smart environment.
- For example is you have connected in your room then you can get notification in your smart phone if it senses motion while you're not home.

Health care is also one major focus of IOT researchers. Many companies and research organization focus on projects and case studies which goal is healthcare improvements and achieving the foundations for a global health system.

II. LITERATURE SURVEY

With the passage of time and development of society, people recognize that health is the basic condition of promoting economic development. Some people say that existing public health service and its supportability have been greatly challenged with respect to time. Worldwide the Government and industry are investing billions of dollars for development of IOT computing, and some of these projects include China's National IOT Plan by Ministry of Industry and IT, European Research Cluster on IOT (IERC), Japan's u-Strategy, UK's Future Internet Initiatives and Italian National Project of Netergit. The IOT applications in the field of medical and healthcare will benefit patients to use the best medical assistance, shortest treatment time, low medical costs and most satisfactory service.

A variety of sensors which are attached to the body of a patient can be used to get health data securely, and the collected data can be analysed (by applying some relevant algorithms) and sent to the server using different transmission media (3G/4G with base stations or Wi-Fi which is connected to the Internet)[X. Boyi, X. Li Da, C. Hongming, X. Cheng, H. Jingyuan, and B.Fenglin 2014]. All the medical professionals can access and view the data, take decision accordingly to provide services remotely.

The IOT technology can provide a large amount of data about human, objects, time and space. While combining the current Internet technology and IOT provides a large amount of space and innovative service based on low-cost sensors and wireless Communication.

IPv6 and Cloud computing promote the development of integration of Internet and IOT. It is providing more possibilities of data collecting, data processing, port management and other new services. Every object which connects to IOT requires a unique address or identification which can be accomplished with the help of IPv6.

Usage of the Web of Things is adaptable and open outcomes to permitting the social insurance applications to serve patients with better treatment, likewise finished with the remote patient checking and powerful restorative information dealing with. There are some of various qualities are expected to actualize the medicinal services benefit in the earth [P.Elanthiraiyan Dr. S.Babu , 2015].

[A. J. Jara, M. A. Zamora-Izquierdo, and A. F. Skarmeta , 2013]presented their own architecture for RemoteMonitoring based on IOT, integration of different systems likehospital information system, services provider system, ContextManagement Framework, Knowledge Base Systems andEnvironment Integration Platform. This architecture uses RFID,wireless personal devices, embedded systems, Monere andMovital hardware, 6LoWPAN, HDP and, the most important, anovel protocol called YOAPY. The proposed protocol appearsto be promising; however, it does not explain the handling ofemergency situations.

[X. Boyi, X. Li Da, C. Hongming, X. Cheng, H. Jingyuan, and B. Fengli, 2014] proposed a semantic data model to store and access the IOT data. The proposed system, called UDA-IOT,highlights how it is used in emergency medical services.They implement the DSS (decision support system) to solve theemergency problems.

[R. Tabish, A. M. Ghaleb, R. Hussein, F. Touati, A. Ben Mnaouer, L.Khriji ,2014] developed 6LowPAN-based ubiquitoushealthcare system called *U-healthcare* which performs thehealth monitoring in both indoor and outdoor

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conditions. Thesystem uses a live streaming platform for reading of remotemonitoring sensors of ECG and temperature.The designed system can store the sensed data at remote serverand use free Cloud service like UbuntuOne. The proposedsystem uses different devices and technologies like router, PC,IPv6, Serial Line Internet Protocol (SLIP), 3G/4G,Microcontroller MSP430 and CC2420, TinyOS and ContikiOpen source operating system, ISR, and Wi-Fi. The proposedsystem is capable to online streaming when the internet speed isgood, also in emergency conditions.
[A. J. Jara, M. A. Zamora-Izquierdo, and A. F. Skarmeta, 2013] present new architecture for Remote Monitoring based on IOT and makes use of a newprotocol called YOAPY. The proposed system is capable tocontinuously monitor the patient health. There are people all over the world whose health may suffer because they don't have ready access to effective health monitoring. But small, powerful wireless solutions connected through the IOT are now making it possible for monitoring to come to these patients instead of vice-versa. These solutions can be used to securely capture patient health data from a variety of sensors, apply complex algorithms to analyze the data and then share it through wireless connectivity with medical professionals who can make appropriate health recommendations.

III. METHODOLOGY

In the system there are four layers. First layer is the sensor layer in which different sensors can be used for sensing the different parameters of the patient such as temperature; pulse rate etc. Second layer is the network layer. We are using ESP8266EX which offers a complete and self-contained Wi-Fi networking solution; it can be used to host the application or to offload Wi-Fi networking functions from another application processor. When ESP8266EX hosts the application, it boots up directly from an external flash. In has integrated cache to improve the performance of the system in such applications. Third layer is the internet layer which contains an internet service provider. Forth layer is the service layer. Three services we are providing that are doctor service, emergency service, and authorized service. All the details of patient are stored in the database and various services make use of that data for providing different functionalities as shown in the Fig 1.

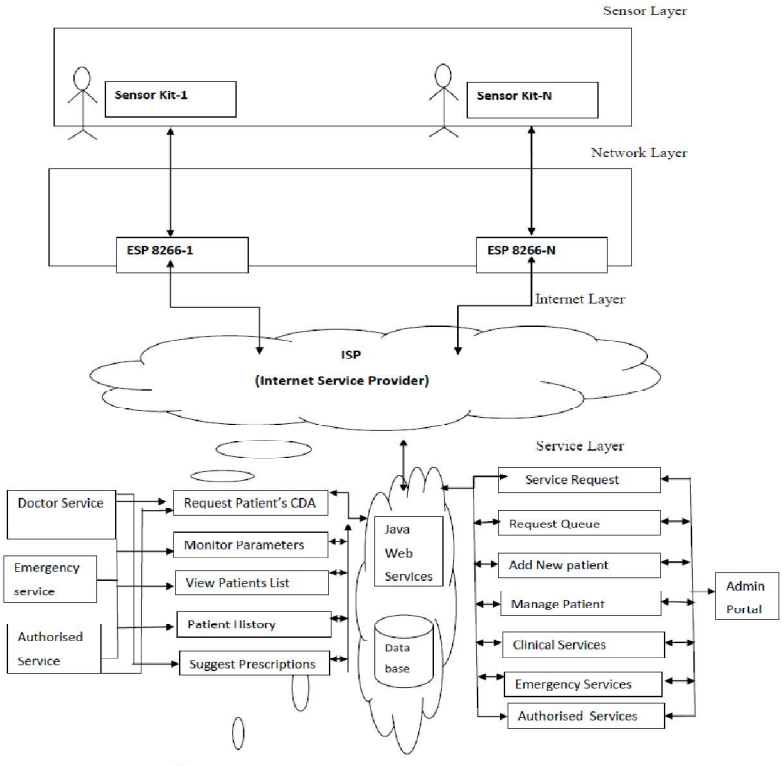

Fig. 1 Block Diagram of System Architecture

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In emergency medical services, to improve the quality of healthcare services, delivering clinic information of patient at the point-of-care to physicians is critical. However, medical records and clinic data are stored in different hospitals; it is sometimes difficult to collect clinic data of patient ubiquitously in case of emergency. In order to continue the ubiquitous content accessing, the resource model to locate and get clinic data which are stored in heterogeneous hospital information systems. Then, a ubiquitous data accessing method is introduced based on the resource model. In the new method, clinic data of patient is defined as resource with unique URL address. Related clinic data of one patient is collected together to form an aggregated resource, and could be connected by physician if authority is assigned to the physician. Finally, case study is discussed to explain the method of clinic data accessing through Internet from different healthcare units. So that that the patient's record could be accessed more conveniently. In healthcare service, doctors, patients, physicians play a major role and they also involved in an entire servicing. Doctors have to access the patient record from anywhere by storing it in a distributed manner. Patients also needs to about the doctors availability and the equipments status (busy/free). In order to help patient accessing doctor's availability status, a resource model is needed for this accessibility.

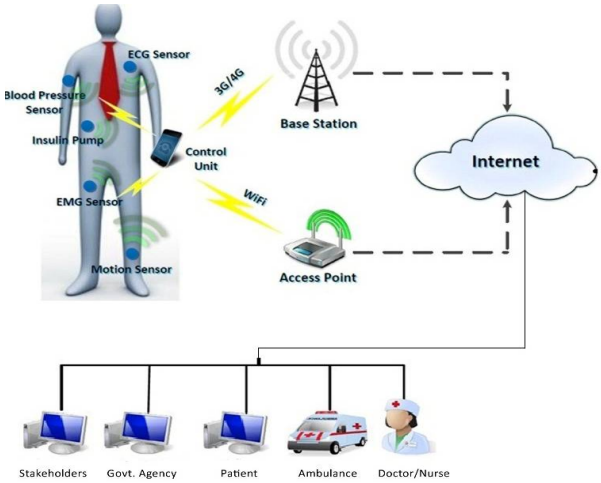

Fig 2 Application Scenario of k-Healthcare Model

The end-to-end connectivity using sensors and other devices in healthcare is shown in Fig 2. Most of the users are using smart phones with built-in sensors. The model provides platform for physical sensors, which are connected directly with patient's smart phone to obtain data at run time. This data is processed and stored in the cloud storage. The stored data can be accessed by practitioners and medical staff later on to observe and monitor patients' health.
There are many cases where a system like this can be used. This is able to use the wearable devices and smart phone sensors to collect the patient data, which is integrated with Internet of Things. In our case, a patient used built-in Heart Rate sensor of his/her smart phone like Samsung Note 4 / S4 to get health related data. The data displayed on the screen of the smart phone, and sent automatically to cloud storage for processing and storing using 3G or Wi-Fi. Machine learning algorithms are applied on data to verify the conditions of the patient. If the value is out of the normal range, then an alert message is sent to a doctor/physician and the doctor will take appropriate action accordingly.
We can evaluate the IOT models based on some parameters such as provision of emergency aid, technology used, standard followed, support for multi device and artificial intelligence implementation.

A. Emergency Aid:
Using IOT in the field of medical and healthcare, the focus should be on data and on the provision of the support in emergencies. The system must generate alarms, inform the patients and consultants.

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B. Technology:

IOT supports different and latest technologies like RFID, WSN, 3G, 4G networks etc. Using these technologies, one can obtain data related to patient's health and send it to a remote server for further processing and storage.

C. Standards:

IOT supports different standards and protocols. Using standards and protocols, we can find the distance, accuracy and time to take a system to complete his work.

D. Multi device support:

We can compare different models and systems on the bases of multi device support. The efficient systems support many devices such as RFID sensors, body sensors, smart phone sensors, tablets, and wearable devices. The k-Healthcare model for efficient deployment of IOT in the field of medical and healthcare consists of four layers[Kaleem Ullah,Munam Ali Shah,Sijing Zhang , 2016].

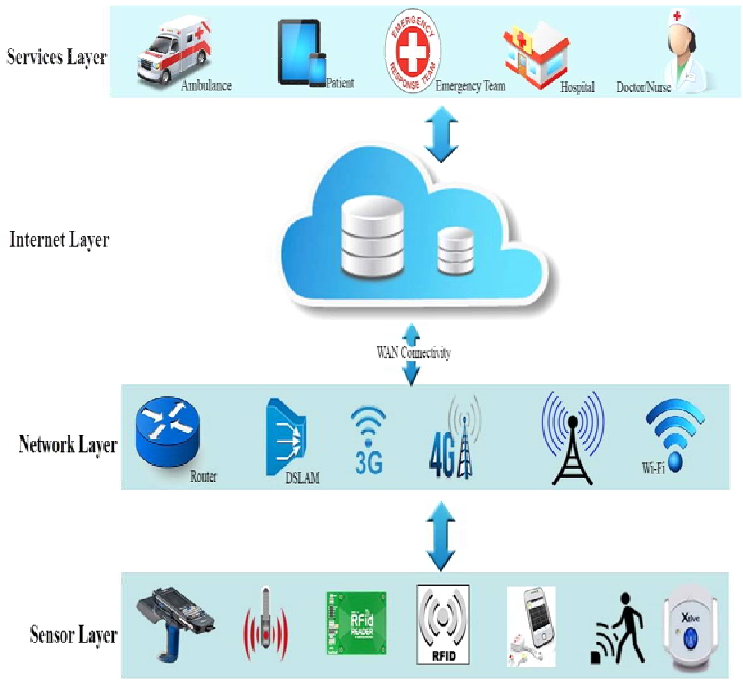

Fig 3 . k-Healthcare Model

A. Sensor Layer

The bottom layer of the model is called a sensor layer which is the heart of the model, there are different sensors lying on this layer, e.g. blood oxygen sensor, pulse oximetry, and Smart Phone sensors. The modern smart phones have certain sensors built-in by default, e.g., accelerometer, gyroscope, proximity, barometer, temperature, humidity, gesture, etc., which makes it easier to use (as no external sensors are used). In k Healthcare we use these built-in sensors to get data and send the data to remote data storage for further Processing.

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B. Network Layer

The Network layer plays the key role in communication to connect the devices with WAN using different protocols(TCP/IP), technologies and standards. The sensor device sends the data to a connected device, e.g. smart phone or RFID reader which is connected to home gate or the Internet via Ethernet / Wireless. The gateway device then sends the data to a particular server for further processing and updating the databases.

C. Internet Layer

This layer provides the functionality of data storage and management. For this purpose, we use the cloud storage. The cloud storage provides the facility to store the data into logical pools. The physical storage may be one server or multiple servers, typically owned and managed by a hosting company.

D. Services Layer

This layer provides direct access of data to professional medical facilities and stakeholders such as doctors, emergency enters hospitals, and medicine supply chains. The doctor can easily manage the patients; view the medication history, and provide remote support in case of emergency. The patient can also access the data on provided interface any time anywhere. This layer supports different protocols and techniques like HTTP, HTTPS, and JavaScript etc.

IV. SIMULATION RESULT

Graphical Analysis

In the graph shown below, on X axis there are number of attempts required to sense the temperature readings of patient and on Y axis there are time in seconds required to send that readings to the cloud database.

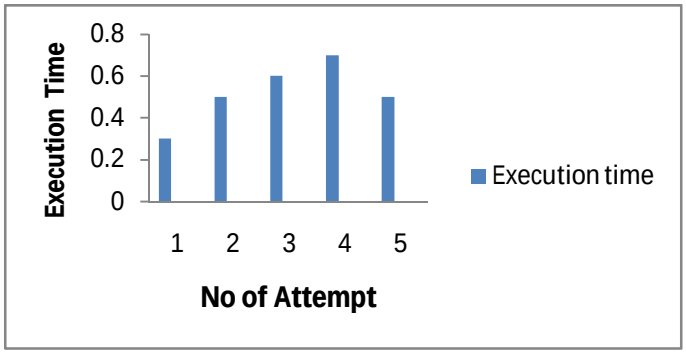

Fig 4 (a).Temperature Sensor Execution Time Analysis

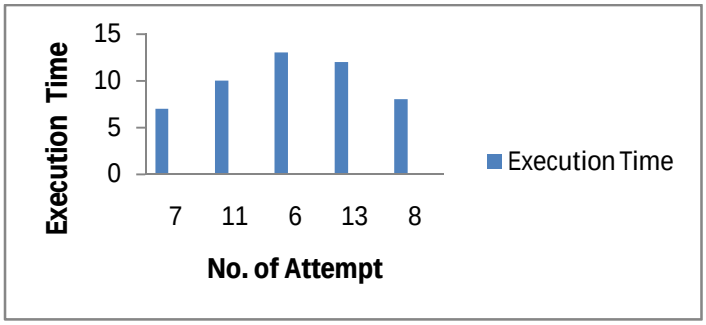

Fig 4 (b). Pulse Rate Sensor Execution Time Analysis

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In second graph, x axis shows the number of attempts required to sense the pulse parameter of particular patient. And on y axis it shows the execution time required to store the values of those pulse parameters in to the cloud database. In comparison with the temperature sensor the pulse rate sensor's values requires more time to get updated into the cloud database.

V. CONCLUSION AND FUTURE WORK

The system named k-Healthcare makes use of four layers which work closely together and provide efficient storing, processing and retrieving of valuable data. It is providing different services remotely, such as prevention and diagnosis against disease, risk assessment, monitoring patient health, education and treatment to users.
The ongoing work focuses on the actual development and deployment of k-Healthcare. One way could be the design of a software or smart phone application which will obtain the data directly from the sensors and process it automatically. Furthermore, we can investigate the security and privacy issues of k-Healthcare.

In Future, wireless sensors can be used so that the hardware complexity will get reduced. We get more compact hardware. We can add number of different services on the service layer and different types of sensors on the sensor layer according particular situation. By extending the services and sensors on the service and sensor layer respectively this model will provide more powerful functionalities that will help in the medical field.

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