Survey on Smart Health Monitoing System using IoT

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***Abstract*—In today's scenario Health care Environment has also become technology dependent. Many humans are facing a panic problem of unexpected death due to the only reason of heart attack, which takes place because of improper and inefficient medical care to patients at right time. So to avoid such kind of problems here in this work a patient need to carry a hardware having sensors which is portable and android phone application, the sensors will continuously sense the body temperature and heart rate of patient and that data is transferred to android smart phone through Wi-Fi/Bluetooth. System also has the cloud database which stores all the required information about patient's health and the role of Doctors is to prescribe medicine using the information stored on cloud. This device even allows patient to move freely and can be continuously monitored. The android phone will contain an application (app) which will detect the signs of heart attack according to the received data and if any abnormalities were found regarding with heart attack quickly message will be send to patient's doctor, his relatives and hospitals. The SMS contains patient's situation and his exact location via GPS to provide urgent medical attention. Staying true to the IoT vision, we propose a smart health care system, which relies on different technologies, specifically RFID, Wireless Networks and smart mobile which interoperates with each other through a Constrained Application Protocol (CoAP)/IPv6 over low-power wireless personal area network (6LoWPAN).**

***Keywords*— Internet Of Things, Cloud Computing, Heart rate sensor, Body temp sensor, Healthcare system, Android, GPRS**.

I. INTRODUCTION

There is always need of better management in hospitals. The database collected from patients should be handy enough. But also, there should be need for data prevention. And also in some scenarios patient data should be kept private. Healthcare is one of the most important concern of many countries in the world. Improving patients live especially in the weaker parts of the society where elderly, mentally and physically disabled as well as the chronically ill patients is the main factor that has to be improved. In existing system, the patient's data is recorded in the form of paper or on the server which is used for general purpose. But the problem is that the patient's data is accessible to all the staff and doctors. Hence we are proposing a new system where patient and doctor are able to communicate through mobile application and web application and which is more secure than existing one [1].

In hospitals as we know that all the parameters of patient like heartbeat, BP can be continuously monitored. There is no such thing when they return to home. And hence there is also a chance that the disease may return again. But here Patient's data (temperature, heart rate, position) will be continuously measured and sent to server. Period of sending signals (say Every 2 or 3 min) can be set [1]. Using Android App in doctor's smart phone, doctor can easily view his patient's health status. When any of the parameter goes beyond the threshold value which we have set he will immediately get an alert intimation.

By using Android App in patient's or his/her caretaker's smart phone the patient and his/her caretaker can view his health status. Early detection and diagnosis of potentially fatal physiological conditions which may sometime leads to death of our loved ones such as heart attack require continuous monitoring of patients health following transfer from hospital to home. Early studies have shown that 30% of patients when discharged from hospitals are readmitted at least once within 90 days with readmission rates ranging from 25 to 54% within 3 – 6 months. In the proposed work we present a smart health monitoring system that uses the sensors for collecting patients input data, intelligently predicts patient's health status and sends collected data to doctors through their mobile devices having Android App. The patients will participate in the health care process by their mobile devices and thus he can access his health information from anywhere and at any time [2].

A. what is IoT

The term IoT was coined by Kevin Ashton in 1999. IoT is all about physical items talking to each other. IoT is composed of two words and concepts "Internet"-The worldwide network of interconnected computer networks, based on a standard communication protocol, and "Thing"-an object not precisely identifiable. "Internet of Things" means "a worldwide network of interconnected objects uniquely addressable, based on standard communication protocols".

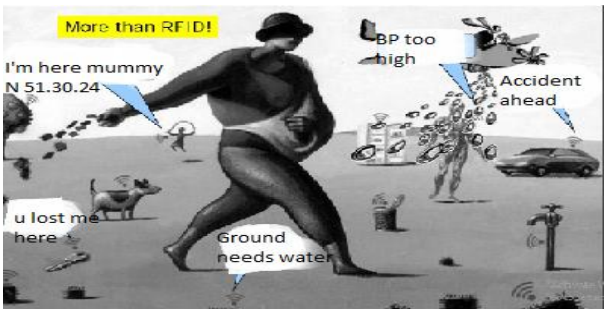

Fig 1. Connected things

Today, developments are rapidly under way to take this phenomenon an important step further, by embedding short-range mobile transceivers into a wide array of additional gadgets and everyday items, enabling new forms of communication between people and things, and between things themselves. A new dimension added to world of information and communication technologies (ICTs) as shown in fig 2:

– Anytime connectivity – Any place connectivity

– For anyone – Connectivity for anything

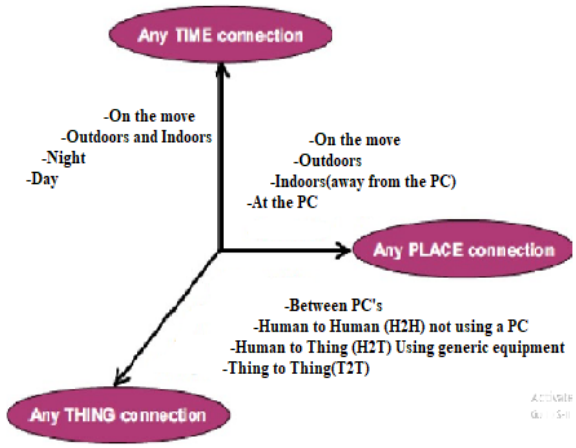

Fig 2. A new dimensions

Connections will multiply and create an entirely new dynamic network of networks – an Internet of Things. The Internet of Things is neither science fiction nor industry type, but is based on solid technological advances and visions of network ubiquity that are zealously being realized.

B. Technologies for the IoT

Initially the requirement for IoT is to connect different everyday objects and may be some devices to some database and also for some network or network of network called as Internet. So an efficient, simple and low cost identification is needed after that data about that connected things can be collected and then collected data is processed for different parts. For this identification we use **Radio-frequency identification (RFID)**. Now collected data will become beneficial to detect any changes in the physical status of connected things, which is done by use of sensor technologies only. The embedded intelligence in all connected things themselves can further increase the power of the network. Finally, the advancement in **miniaturization and nanotechnology** helps the proposed system to be much small as possible because it helps the target device to be portable. A collection or combination of all of these devices and development leads to create an Internet of Things that connects the all over world's objects.

- *RFID technology:*

In this paper the RFID Tags are used to establish the wireless communication. The RFID tags are simple chips which are used for the identification of objects. The RFID reader sends a question signal to the tag and receives mirrored signal from the tag, which is then passed to the database for storage purpose [5]. Figure 1 shows the RFID Network using Sensor. In this figure the RFID tags send the signals to the static node receiver, the static node receiver sends the signal to the mobile base station, directly to the mobile phone. Then by using the GPRS and through the internet it is pass to the server for display purpose. In the Smart healthcare system the IoT and RFID plays an important role. In this system the different sensors are embedded in the patient body and according to the signals from the sensors, RFID and IoT the patient can be monitor. The RFID tags commits entity recognition involuntarily through evaluation the tag that joined to objects [8]. There are two types of RFID tags are presents viz. active RFID and Passive RFID.

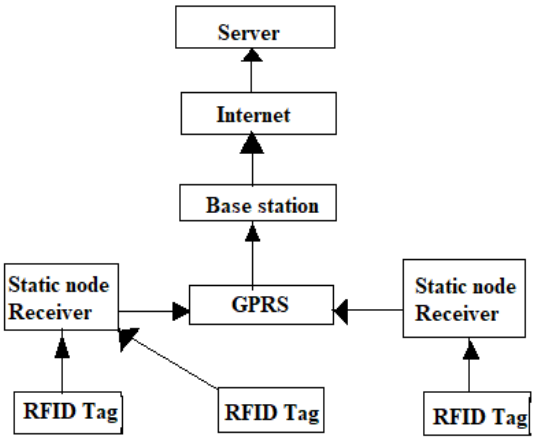

Fig 3. RFID network using sensors

` Usually passive RFID tag utilized for negligible power consumption, RFID tag reader yield the power though which it energetic for transmission with reader. Essential goal of sensor network to prominently acquiring data from context and ships it to the domestic cache warehouse [2]. IoT allows to users to use to surf the Internet cordlessly with various equipment, e.g., tablets, smart phones and handheld electronic appliances. 2G/3G/4G are the GSM standards for communication exploited by Internet. LTE 4G or 3G networks are required in RFID based network. Practicing such competences, solitary get statistics linked to cases health and drive up to distant base station furthermore reckoning and repository [5].

- *Sensor Technology:*

- The ability to detect changes in the physical status of things is also essential for recording changes in the environment. In this regard, sensors play a pivotal role in bridging the gap between the physical and virtual worlds, and enabling things to respond to changes in their physical environment. Sensors collect data from their environment, generating information and raising awareness about context. For example, sensors in an electronic jacket can collect information about changes in

external temperature and the parameters of the jacket can be adjusted accordingly.

- *Miniaturization and Nanotechnology:*

It means that smaller and smaller things will have the ability to interact and connect.

C. Applications of IoT

There are several applications of networked Things in Agriculture, Healthcare, Retail, Transport, Environment, Supply chain management, Infrastructure monitoring etc. Some of them are listed below:

Agriculture: Applications in Agriculture include Soil and plant monitoring, Monitoring of food supply chain, Monitoring of animals.

Retail Management: Retailing has many applications areas of business interest. It includes monitoring customer behavior and preferences, Shelf stock tracking, context based advertising and product promotions, vending machines, automated checkout, and theft control.

Healthcare: Identification of spurious drugs is a major application in healthcare area. Other application areas are personal health monitoring, telemedicine, assisted living.

Security: Detection of counterfeit goods, Access control, Restricted materials, Banknotes, Passports Government and public sector: Disaster management, Forest monitoring, Tourism support, Homeland security, Pollution monitoring

Smart home: lighting, entertainment, energy management, assistance.

II. RELATED WORK

Recently advancement in MEMS (micro electro mechanical systems have opened great opportunities for the implementation of smart environments. Especially in the medical field, different sensors are used to evaluate different types of vital signs (i.e. heartbeat, temperature, and body pressure, ECG, and motion etc) have been developed, thus enabling the design of innovative services able to substantially improve citizens' healthcare. In this field, among the several research activities already presented in the literature, those related on the use of the UHF RFID technology are mainly focused on tracking patients in hospitals and nursing institutes.

RFID technology has been successfully used for equipment localization in hospitals. As evident from the literature, since RFID tags can operate only under the reader coverage region, hence the use of UHF RFID technology is limited to patient/devices monitoring and tracking in small environments. Another set of related work proposes the use of WSN technology [6] to implement solutions able to meet the specific requirements of pervasive healthcare applications. In a WSN providing patient localization, tracking, and monitoring services within hospital is presented.

III. EXISTING SYSTEM

In existing system Patient and environment monitoring would be considered as an individual application system in healthcare automation environment. Integration of both environment and patient monitoring does not exist. Doctor has to generate the patient report in a hospital only. In case of any emergency the doctor at any circumstances must be in hospital to generate a prescription. If a doctor is in some other location apart from hospital then doctor may send report via messages or by call which may lead to conflicts. So a mobile based application of a patient is mandatory to the doctor, so that a doctor can provide prescription from any place.

IV. PROBLEM DEFINITION

- There is redundancy of data in existing sensor network.
- Issues in Communication and Data management sensor Network.
- In case of any emergency occurred then doctor must be in hospital to generate prescription.

V. PROPOSED SYSTEM

Our proposed system is to implement an IoT Smart Healthcare System. Smart Healthcare Systems for automatic monitoring environmental conditions of a hospital as well as to monitor health conditions of a patient. Sensors are used to sense the environmental conditions i.e. (temperature, humidity, ambient light etc.) in the hospital the local staffs are responsible for tracking environmental conditions of the ward. By using a RFID reader sensor identity can be verified to ensure Authenticity and Integrity. The Nurse in the hospital is responsible for tracking and monitoring the patient health condition. Based on the patient description the patient's id will be updated to the nurse. The data which is being monitored is temperature and a heart rate. The Nurse starts her work of monitoring the patient data i.e. (temperature and heart rate) are updated in the nurse page and based on the temperature and a heart rate, values starts to be display in a dynamic graphical chart. After that monitored details will be sent to the doctor. Based on that details doctor will generate a graphical chart and give prescription. The graphical chart and the prescription will be created as a PDF File and send to that patient mobile.

This section reports the components used while developing this system. This venture configuration comprises of association between micro controller and actuator to procure faithful estimation, and watching and evaluating the cases condition eventually grows the strength of loT in healthcare. Types of sensors used are ECG sensor, Blood Pressure sensor, Temperature sensor, Motion sensor, EEG sensor and Blood Glucose sensor. The combination of micro controller with the smarts sensors offers advantages like as incorporated precision analog capabilities, small power consumption and easy for designing GUI's. The Figure I shows patients healthcare model by using loT. It consists of the sensors which are attached to human body, Microcontroller, Analog to digital converter (ADC),

wireless devices like as Bluetooth, RFID, Mobile Phones, Wi-Fi system, Internet devices and doctors/nurses, hospitals, emergency team, Ambulance, Government Agencies, etc. which provides the facility to the patients for their healthy fare [9]. The sensors continuously collect the information from the patient's body to get the patient details. In case of any emergency, these wireless devices can distantly report the physical condition of the patient to his doctors and/or relatives. In such condition the doctors and hospitals can respond with emergency medical services such as ambulance or provide the necessary actions to the relatives for aiding them to help the patients [10]. In Figure I different sensors are attaches to the patient's body to measure the different parameters like as EEG, blood pressure, Body temperature, Blood Glucose, ECG and Motion. The signals generated from these sensors are in analog form making it necessary to be converted into digital form for which ADC is used. These digitalized signal form the ADC are forwarded to RFID/Bluetooth device through microcontrollers. RFID/B1uetooth devices wirelessly transmits these signal to the mobile phone for the transmission of data through internet to the specific destination. The internet either uses the base station or internet for the transmission purpose.

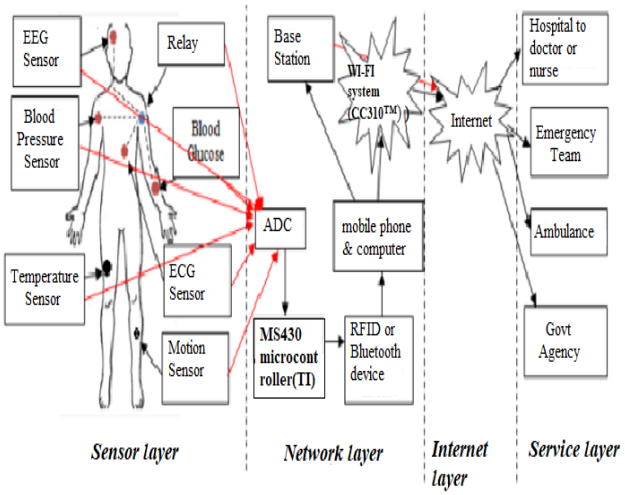

Fig 4 . BLOCK DIAGRAM OF PROPOSED SYSTEM

All these operations can be done into four different layers and providing different services to each other for combined functioning those layers are:

- Sensor Layer
- Network Layer
- Internet Layer
- Service layer

All the description of these layers are discussed in later sections and hence the block diagram of proposed system is shown in figure 4.1.

A. *Sensor Layer*

This is first stratum of this system which is the essential part of the proposed system. As shown in figure there are different sensors presents such as EEG Sensor, Blood Pressure Sensor, Temperature Sensor, Blood Glucose, ECG Sensor and Motion Sensor. Each of these sensors monitors and collects respective information and transfers it to the next layer, i.e. network layer.

B. *Network Layer*

This level performs a significant task in conversation which is used for attaching appliances to network by means of divergent protocols like as 2G, 3G, 4G, with Routers. Network level moreover promote dissimilar message passing standard protocol suite such as WAN for 3G, MAN for 4G IEEE 802.20, ITU G.992. I - ITU G.992.5. The Bluetooth set up the connection between two devices [9]. When two devices are demanding to be paired, they are actually searching transmit and receive data between two Bluetooth devices [9]. The data send and received at a time is equal to 720 Kilo bytes per second. The Wi-Fi was invented by NCR corporation/AT&T in Netherlands in 1991. By using this technology we can exchange the information between two or more devices. Wi-Fi has been developed for mobile computing devices, such has laptops, but it is now extensively using for mobile applications and consumer electronics like televisions, DVD players and digital cameras [10]. Android is the most popular operating system in the smart phone. Google reprieves the code below the Apache pennit which is exercised by Android OS for touch screen gadgets. Java language is exercised for creating android functionality. Analog to digital adaption is an electronic course in which endlessly capricious wave is reformed, except amending its basic content, through a multilevel wave.

The type of microcontroller used in this system is **MS430 and CC3100 (by Texas Instruments)**. The microcontroller is connected to all other hardware units in the module. This module takes analog parameters from the sensors which is attached to patient, process it and convert them in digital output. And also this module contains Wi-Fi connectivity device which helps to send the sensors converted data to the android smart phone [7].

The **MSP430™** is a 16-bit microcontroller which is of ultra-low power RISC mixed-signal microprocessors from TI. It also provides the best solution for a wide range of low power and applications suited for portability. Texas Instruments provides robust design support for the MSP430 16-bit MCU, which includes all technical documents, training, tools, and software. We know that every controller is based on some architecture like Harvard, Von Neumann etc. Similarly MSP430 microcontroller is based on a Von-Neumann architecture. Mainly Texas Instruments designed MSP430 MCUs to consume ultra-low power and to serve for wireless enabled applications.

The **CC3100™** used here will connect any of the low cost and low-power microcontroller like MSP430 to the Internet of Things (IoT). CC3100 provides wireless networking solution which is also a part of the new Simple Link family of Wi-Fi that simplifies the implementation of Internet connectivity which is needed for wireless sending

and receiving of data. The CC3100 device co-ordinates all protocols used for Wi-Fi and internet. With inbuilt security protocols, the CC3100 also provides a robust and also a simple security experience. Additionally to that, CC3100 device provides a complete platform solution which includes guides for programming, some sample applications, tools and software and also provides some reference designs for better understanding of the device.

C. Internet Layer

This layer establish the connections between the network layer and service layer.

D. Service Layer

In this layer the direct the data came from the internet is directly access by the doctors/nurse, emergency team, ambulance and government agency. According to this information the above professionals may effortlessly supervise the cases, outlook prescription details, and furnish central assist in the event of necessity. Network stratum assist various protocols and proficiencies for accessing web utility for carrying information to the devices.

VI. APPLICATIONS OF THE PROPOSED SYSTEM

The mobile based application for a doctor and patient some of the features of that application are:

1. Patient has the option to see the report any time.
2. The doctor can provide prescription and generate a report for a patient from any location.
3. Continuously patients are under observation.

VII. CONCLUSION

In this paper, IoT based smart health care system architecture for automatic and continuously monitoring and tracking of patients, personnel, and biomedical devices within and outside of hospitals and nursing institutes has been proposed. Where the Medical App is installed on the Mobile phone and uses the Wi-Fi or 3G Internet access. When a patient-fall event is detected the application receives it and notifies the doctor with a sound. The Medical App also allows the doctor to retrieve from the IoT Smart Gateway further details on the occurred event and the last registered patient location. This approach will supervise the anatomical arguments of the cases and any variations in pre-set parameters will trigger alerts been sent to the medical professional.

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