

Implementation of Internet of Things (IoT) In Developing Semi Artificial Intelligent Healthcare Monitoring System

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Abstract—This research work aims to utilize the Internet of Things (IoT) technology in the field of healthcare monitoring Systems. Healthcare monitoring systems have always been evolving and with the help of IoT, it can be taken to a next level. Implementation of IoT with healthcare monitoring system will enable the communication of consistent data about the patient to medical staff, doctors, hospitals, caretakers over the internet and can be accessed from anywhere and at anytime. To realize this concept a system is developed which comprises body sensors to collect vital data, a communication channel to transmit data and utilizes IoT concept to aggregate and analyze data for meaningful deductions. This device is capable to provide continuous monitoring of health parameters of the patient. The involvement of IoT will ensure that a complete track of medical history record of patient is available over the internet and is accessible anytime during emergency. Over the period of time the system would become intelligent enough to provide necessary prescription to the patients based on their previously stored medical diagnosis report and prescriptions. Thus based on the data stored over the time a Semi Artificial Intelligent system gets created which helps in reducing the medical cost significantly and would also save important lives.

Keywords: Patient Monitoring, Internet of Things (IOT), GSM module, sensor network

1. INTRODUCTION

Internet Of Things is a growing concept that is being discussed and researched increasingly both inside and Technology Work-space and outside of it. A simple definition about the concept could be as "a network of electronic devices which are capable of transmitting data and are connected to Internet". The devices could be anything right from your smart phone to a flying aircraft is big giant connection of devices where everything is connected to everything by means of data transmitting devices. Reduced cost of connection due to widespread reach of internet, more devices with Wi-Fi capabilities, incorporation of sensors in most of devices, reducing cost of technology are some of the factors which provide a perfect platform for IoT to launch. Internet of things is a promising paradigm to integrate several technologies and communication solutions [1]. Internet of things is a new phase

of information technology. The medical information technology has the widespread function in modern applications [2]. So far there are many e-healthcare devices has been developed utilizing several methods. Various health care ATMs and air ambulances is being launched in India at different places to compete with the fast growing demands of healthcare services. Health-IoT ecosystem today is based on a network of devices that connect directly with each other to capture and share vital data and information through a secure communication service [3]. Within this new trend, there are intelligent devices that have a digital entity and are ubiquitously interconnected on a network and to the global Internet [4]. The demand for network of interconnected devices is spread across multiple industries including automotive, energy, manufacturing and communications; however healthcare Industry is the one which has absorbed the concept of IoT the most. The reason being that healthcare monitoring involves a lot of signaling and vital data generating devices which needs to be analyzed and processed to diagnose a patient's health and provide a prescription. In addition BIG DATA Analytics has played a pivotal role in popularizing IoT in healthcare by providing the meaning to the collected data.

Implementation of IoT in healthcare sector will provide a new way to develop things in order to enhance the technology. Implementation requires incubating the physical things with a virtual environment where devices can interconnect with each other and shares relevant information among them. After successful implementation of IoT in medical healthcare devices the system will be able to transmit the patient data to the medical staff, doctors and over the web server. Wireless sensor networks have been deployed in various monitoring applications such as industrial, health, environmental, and security. The Wireless Sensor Networks consisted of relatively inexpensive sensor nodes that are capable of collecting data from patient, processing all those data through controller and transferring information from one node to another.

The present e-healthcare monitoring system measures the vital signals of human body like heat beat, temperature, falls etc.

continuously and simultaneously provides the data over the web server and to the medical staff in case of emergency so that further actions can be taken to save a person's life. Internet of Things (IoT) fulfills the ever growing demands of more efficient and reliable smart e-healthcare systems. The complete model will consist of sensor network which can also be called as body area network that receives data of patient body and processes it with microcontroller and after that provides the information of causalities using Wi-Fi module which transmits that over the internet. The components required to develop the system are temperature sensor, heart beat sensor, microcontroller (Atmega8), Wi-Fi module and a central hub. The designed system will be of low cost, compact size more efficient wireless device which can monitor human body parameters accurately in real time. In future Internet of Things (IoT) will gather the data and after analysis provides real time monitoring of patients and provide an open, private or hybrid gateway.

2. LITERATURE SURVEY

The quality of the health care is improving day by day due to the advancement in medical science and technology [5]. Most recent work is in the direction of developing wireless sensor networking for health care monitoring system is reported in [6, 7, 8, 9]. However all reported systems are less cost efficient, so there is always a need to develop the monitoring system using optimum number of sensors and various communicating devices that can overcome such limitation.

2.1 Related work and Motivation

Santos A. et.al, [4] describes system utilizing smart objects and Internet of Things for controlling action in M-healthcare Trucu C.E. and Trucu C.O [10] proposed a IoT based approach and its application in healthcare science. Sundharakumar K.B. [11] designed a cloud based fuzzy healthcare system using sensor automation and big data analysis. Gnavati S. [12] focuses on the designing of congestion detection and control scheme using fuzzy logic technique in wireless body area networks. Simulation results show a significant performance in terms of network.

2.2 Supporting Technologies

A lot of work has been carried out for developing the health care monitoring system. Most recent work is in the direction of developing wireless sensor networking for health care monitoring system. There are many wireless technologies that existing nowadays, are used for medical care. Till now healthcare devices have been developed using various protocols such as ZigBee, Bluetooth and Ethernet which are discussed below in table 1.

Table 1: Supporting technologies of (IoT)

Technologies	Mode	Frequency	Band-Width	Range
IEEE 802.16 5 WBAN	One way	3-10 GHz	>500 MHz	1 to 2 m
IEEE 802.15.4 ZigBee	One way	2.4 GHz	5MHz	0-10 m
IEEE 802.15.1 Bluetooth	One way	2.4 GHz	1MHZ	Upto 1 km
GSM module	Two way	2.4 GHz	Tri Band 900/1800/1900MHz	100m- 1km
RF communication	One way	3Hz to 300GHz	>850MHz	Upto 25 m

3. OVERVIEW OF PROPOSED SYSTEM

The health care monitoring system with wireless sensor network is used for patient monitoring. In old days, it was difficult to transmit the status of patient to hospitals at the time of emergencies. It was done through telephony network. Today, wireless sensor network has been adopted to provide mobile telemedicine which allows patients to engage their daily routines while they are monitored continuously anytime, anywhere. Such a healthcare monitoring system provides continuous observation of patient and using internet to transfer the information to the web server.

In the era of internet and with the advent of IoT, we need to move ahead from healthcare to E- healthcare. This would enable maintaining a more accurate and consistent data record for healthcare monitoring system. This would just require a wearable monitoring device utilizing wireless communication to transmit data and implementing IoT to connect different devices and interfaces for the purpose of keeping a track of patient's health parameters is something which is simple as well as robust.

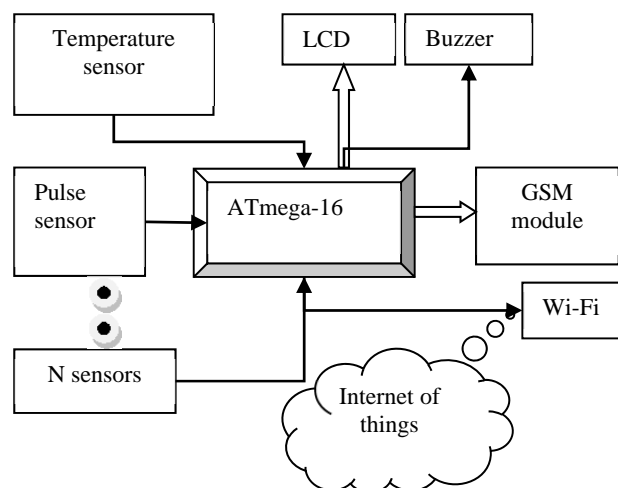


Fig. 1: Proposed block diagram of system hardware

The figure1 shows the proposed block diagram of system hardware for developing healthcare monitoring unit. The hardware unit will consists of temperature sensor and heart beat sensor. We can integrate more sensors like pulse oximeter, impact sensor and nasal flow sensor etc., to create a body area sensor network. These sensors embedded with ATmega 16 microcontroller. At the output side LCD and buzzer are placed to get the alert message in case of causality. A predefined range is set for the sensors. The body area sensors will continuously collect the data from the patient body and then transmits analogue signal to microcontroller where an in-built analog to digital converter converts vales in digital data. As the readings goes beyond the preset limits, in case of medical emergency, the GSM module/Wi-Fi transmits the readings to and centralised database via internet to and hospital staff. Wi-Fi module can be placed at the wearable device to connect the device with the server. The hardware of this module can be made to communicate with other interfaces and devices by utilising concept of IoT. The idea also proposes to make such a device smart on the basis of stored medical history of patient's.

4. IMPLEMENTATION OF INTERNET OF THINGS

Internet of things can be implemented with a wide range of available technologies and create an analyzed and processed information from the aggregated data using big data techniques. For creating this value we need to gather all useful data that needs to be communicated, aggregated and should be analyzed in such a way that develops a new and more effective action. The implementation of IoT can be done in any electronic device that is capable of transmitting data. In IoT concept the connection could be between device to device, device to person or person to person. Realizing the IoT's full potential motivates a framework that captures the series and sequence of activities by which organizations create value from information [13].

With the recent advancement in Internet Of Things the patient can still be monitored remotely and controlling action can be taken post hospitalize so that a consistent, compliant and real time accessible data could be maintained about the patients health parameters.

As shown in Fig. 2 a five circle loop of IoT, for information to complete the loop will create value, it passes through the stages of the loop, each stage enabled by specific technologies. An act is monitored by a sensor, which creates information If the data is aggregated and analyzed correctly then a system could be developed which can provide a recommended prescription based on the previously stored prescription provided by a certified doctor in the database for certain set of body parameters of patient. Over the time such a device possibly can have a kind of artificial intelligence (provided the correctness of previous prescriptions) which will be able to provide a recommended prescription or some kind of actions to be taken based on previous data for the same set of body

parameters and all this would be accessible through a portal on internet. Thus, if not complete however a semi- Artificial Intelligent Health Monitoring Device could be created which can provide prescription without the need of a doctor in some of the common problems faced by patients on a regular basis .A lot is there in this space for exploration and development.

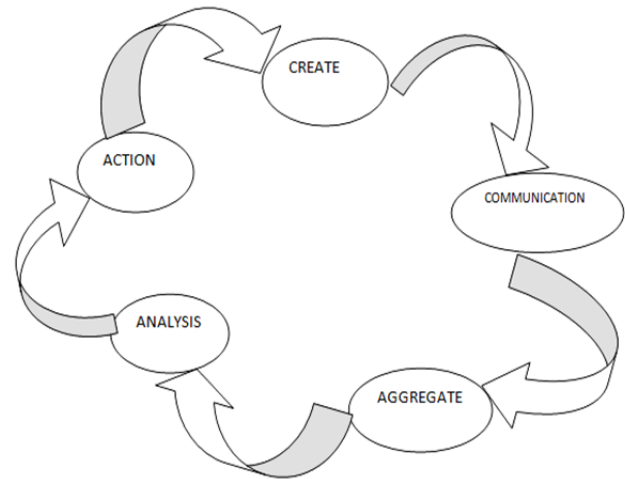


Fig. 2: Five circle loop of IoT process

5. SYSTEM CO-DESIGN AND WORK FLOW

The work flow of entire proposed system can be represented as shown in Fig. 3. The development of creating a valuable information over the internet will be processed according to the flow diagram.

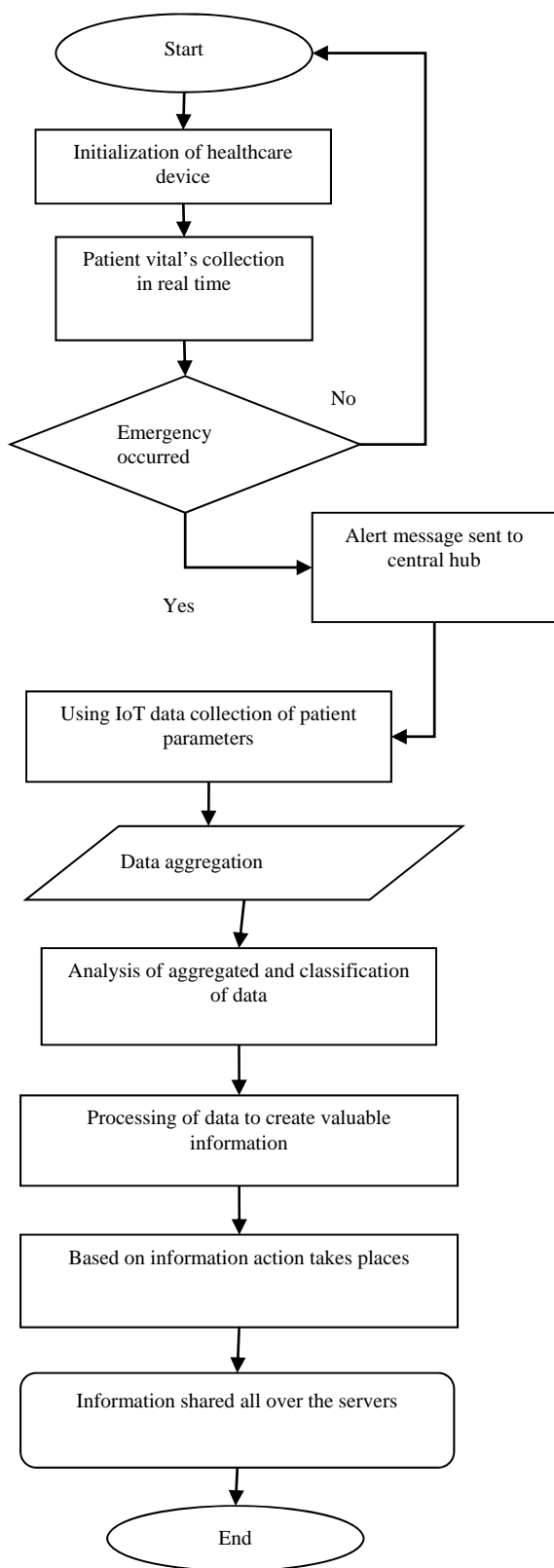


Fig. 3: Work flow of proposed system

6. CONCLUSION AND FUTURE WORK

The paper proposes a simple and robust way of implementing IoT in Healthcare Monitoring System by means of using a wearable device. Such a device will not only improve the monitoring of a patient's health post hospitalization, but also will provide a sense of security to the patient and their care takers. Such a device if improved further will remove the overhead of keeping patient's medical records intact and will also provide the ease of accessing those records on internet during emergencies. The use of this simple idea and device will help cutting down the medical cost spent on repetitive consultation and prescription. This paper is just a glimpse of advancement that IoT is going to make in healthcare Monitoring units. The use of such integration can be developed further to create models which will have artificial intelligence which will definitely feed to the shortage of doctors and medical staff in developing countries like India, China and Brazil. Proper analysis and smart engineering design coupled with good medical diagnosis reports would result in Autonomous e- healthcare monitoring systems.

REFERENCES

- [1] Rahmani A.M., Thanigaivelan N.K., Gia T., Granados J., Negash B. and Tenhunen H., "Smart e-Health Gateway:Bringing Intelligence to Internet-of-Things Based Ubiquitous Healthcare Systems"*IEEE consumer communication and networking conference*, 2015 pp 826-834
- [2] Bulgiba A M, "Information technology in health care--what the future holds", *Asia-Pacific journal of public health / Asia Pacific Academic Consortium for Public Health*, vol.16, no.1, pp.64-71, 2004.
- [3] Farnandez F. and Pallis G.C., " Opportunities and challenges of the Internet of Things for healthcare", *ICST wireless communication and healthcare*, 2014 PP 263-266
- [4] Santos A., Macedo J., Costa A., M. João Nicolau, "Internet of Things and Smart Objects for M-Health Monitoring and Control" *Science Direct Procedia Technology* 16 (2014) 1351 – 1360
- [5] Liu Y, "The Design and Implementation of a Virtual Medical Centre for Patient Home Care", *20th IEEE Annual International Conference of Engineering in Medicine and Biology Society*, Vol. 3, pp. 1163-1165, Hong Kong, 1998
- [6] Golmie N, Cypher D and Rejala O, "Performance Evaluation of Low Rate WPANs for Medical Applications", *IEEE Conference of Military Communications*, Vol.2, pp. 927-933, 2004.
- [7] Townsend K.A, Haslett W, Tsang T.K.K and Gamal M.N, "Recent Advances and Future Trends in Low Power Wireless Systems for Medical Applications", *5th IEEE International Conference of Database Engineering & Application Symposium*, pp. 476-481, 2005.
- [8] Xijun C, Meng M.Q.H, and Hongliang R, "Design of Sensor Node Platform for Wireless Biomedical Sensor Networks", *27th IEEE Annual International Conference of Engineering in Medicine and Biology Society*, pp. 4662-4665, Shanghai, China, 2005.

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- [9] Paksuniemi M, Sorvoja H, Alasaarela E and Myllylä R, "Wireless sensor and data transmission needs and technologies for patient monitoring in the operating room and intensive care unit", *27th IEEE Annual International Conference of Engineering in Medicine and Biology Society*, pp. 5182-5185, Shanghai, China, 2005.
- [10] Trucu C.E. and Trucu C.O, " Internet of Things as Key Enabler for Sustainable Healthcare Delivery " *Procedia - Social and Behavioral Sciences* 73 (2013) 251 – 256
- [11] Sundharakumar K.B., Dhivya S ,Mohanavalli S, Vinob C,"cloud based fuzzy healthcare system", *Procedia computer science* 50 (2015), pp 143-148
- [12] Sara Ghanavati, Jemal Abawajy And Davood Izadi, "A congestion control scheme based on fuzzy logic in wireless body area networks", *14th IEEE conference on network computing and application* (2015)
- [13] Cousin M, Castillo-Hi T and Snyder G "How the IoT is transforming medtech" in *Deloitte University press*, 2015