International Journal of Scientific Research in Computer Science, Engineering and Information Technology
 | Volume 3 | Issue 3 | ISSN : 2456-3307

Critical Care Monitoring with Event Priorization Using IoT

A. Rumana[1], J. Padmavathi[1], K. Saru Priya[1], A. Nida Mahnaaz[1], R. Suvarna[1], S. Surya[2]

[1]UG Scholar Computer Science and Engineering, Faculty of Engineering, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, Tamil Nadu, India

[2]Assistant Professor, Department Computer Science and Engineering, Faculty of Engineering, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, Tamil Nadu, India

ABSTRACT

The Internet of Things (IoT) provides an efficient and new life to the healthcare field. It also has a rapid development of many fields. The impact of the IoT on the evolution towards next generation smart environments will largely depend on the efficient integration of IoT and cloud computing technologies. But the more important are real in the field of Medical. Existing related research works on sensor cloud have primarily focused on the ideology and the challenges that wireless sensor network (WSN)-based applications typically encounter. However, none of the works has addressed theoretical characterization and analysis, which can be used for building models for solving different problems to be encountered in using sensor cloud. One of the better ways, the doctors are capable to certainly and quickly right to use the relevant patient information's and including the patient medical history. Through the Internet of Things, tremendously improves the quality of information and the patient care in the Medical field. So, Internet of Things offers an actual platform to interconnect the all the resources. However, the diversity of the objects in IoT causes the heterogeneity problem of the data format in IoT platform. Meanwhile, the use of IoT technology in applications has spurred the increase of real-time data, which makes the information storage and accessing more difficult and challenging. The proposed system presents the architectural review of smart health care system using Internet of Things to provide Quality Health Care by validating the measure patient's body parameters. Based on the evaluation model, decision model is applied and the system prioritizes the critical data by checking the critical level of sensed information and the report is generated & provided to the doctor, caregiver and relatives to the patient. Passive monitoring and active monitoring system are applied to validate the criticalness of the patient.

Keywords : IoT, Health Care, Event Prioritization, Reporting

I. INTRODUCTION

Keeping track of the health status of your patient at home is a difficult task should be periodically monitored and the people need to be informed about their health status time to time while at work. A system puts forward a smart patient health tracking system that uses sensors to track patient health and uses internet to inform the people in case of any issues. System temperature as well as heart beat sensing to keep track of patient health. The sensors are connected to a micro controller to track the status which in turn interface to an LCD display and WIFI connections to transmit alerts. If system detects any abrupt changes in patient heart beat or body temperature, the system automatically alerts the user about patient status over IoT and also shows details of heart beat and temperature of patient live over internet.

Although the present systems allow the continuous monitoring of patient's vital science, these systems require sensors to be placed bed side monitor or PC's, and limit the patient to the bed but now there is no relation between the sensor and bed side equipment due to wireless devices and networks. These systems do not require the patient to be limited to the bed and allow patient to move around but requires being within a specific distance from the bed side monitor. In most cases health monitoring will be done by infrastructure oriented wireless network such as commercial cellular/ 3G network or wireless LAN's in most system health data from multiple patient can be relayed wirelessly easing multi hop routing scheme to a base station. The patient's physiological signals are acquired by sensors attached on patient's body and are then transmitted to the remote based station and also PC for storing and analysing.

The Internet of Things (IoT) provides an efficient and new life in medical field. It also has a rapid development of many fields related to the medical. The IoT is the emerging paradigm, which contains a huge amount of smart objects and smart devices connected to the internet for communicating with each other. IoT devices are used in many fields which make the users day to day life more comfortable. In recent years, the growth of internet is tremendous and has been further extended to connecting things through the internet. All devices are connected to one another with various smart technologies to create a worldwide ubiquitous network called IoT. The impact of the IoT on the evolution towards next generation smart environments will largely depend on the efficient integration of IoT and cloud computing technologies. The IoT is all about physical items talking to each other, machine -to- machine communications and person to computer communications will be extended to "things".

The key technologies that will drive to the future IoT will be related to smart sensors technologies, including the WSN, Nanotechnology. The IoT is an emerging concept referring to networked everyday objects that inter connect to each other via wireless sensors attached to them. Smart homes are an appealing IoT practice. Internet of things is the primary technology for interconnecting all the medical resources of the rehabilitation systems. Also, to combine the networking technologies that enable a wide range of applications, devices or things to interact and communicate among themselves. The majority of this interactions happens to through the world wide web, with client devices running a browser and communicating with cloud based servers.

Health is primary element that human requires. It is important for individual as well as for the growth of society. Health is primary element that human require. The developments regarding the Internet of Things in healthcare also need to be seen in the context of the digital transformation of the various healthcare segments.

IoT, from a perspective, is a corner stone of the digital transformation of healthcare until at least the next decade. The usage of cellular agent in healthcare procedure underneath wi-fi community environment gives a chance to explore improved services for patient and staffs reminiscent of medical professionals and nurses given that of its mobility.

II. LITERATURE SURVEY

Sarkar et al (2016), presents a model for fog computing architectures with edge or fog nodes forming an intermediate layer between device and cloud layers. The authors show how the fog layer enables relevant energy savings when supporting IoT applications, but do not provide any optimization strategy to distribute the service functions over the entire infrastructure.

Farris et al (2015), develop a federation strategy among IoT devices and clouds so they can share their computing resources in order to maximize the total number of executed tasks. Stefano et. al (2015) proposed a detection system to monitor the movements of patients which recognizes a fall and automatically sends a request for help to the caretakers. Security is a key concern in the IoT devices management.Gennaro et. al. (2014) developed a personal health diagnosis based on the symptoms of the patient. A huge amount of collected data is used to analyse the disease and risk of the patients.

Franca (2014) discussed that the innovations of the new generation systems are the development of continuous monitoring features for the patient and the improvement of workflows and productivity of medical personal. He also emphasized the various wireless technologies and the advantages of using those technologies for faster communication.
Mohammed (2013) discussed that the key distribution is required to secure the e-health applications. Mohammed modelled a protocol for key management which allows the captured data to be transferred in a secured channel. An IoT deployment in healthcare needs more security because the data of any patients is more sensible and it should not be misused by any bad elements in the society. Cristina et.al. (2013) developed an approach to maintain health care data of a patient collected in different geographic locations.

The data is available to doctors, hospitals, laboratories etc., to check the medical history of the patients. Jieran et al. (2012) developed a Radio Frequency Identification technology and intelligent systems, which detect the disinfected articles and alerts the medical staff to wash the hands after the contact with the disinfectant articles. Data sensed and transmitted through the wireless devices are received in the local system that needs to support accessing of data in heterogeneous formats, can be useful in building real time applications and to be updated in the mobile application of the doctor as well as the user (patients or caregiver). Boyi et. al. (2011) presented IoT based system for providing support to emergency medical services by demonstrating how IoT data can be collected and integrated for interoperability.

Long et. al. (2010) discussed the necessary and requirements details of the software for healthcare and proposed an architecture for healthcare and IoT. They have taken the parameters like ECG, blood oxygen, respiration, temperature. With the increasing health related problems and lack of proper solution in healthcare to monitor the patients in the absence of doctor, the patients face serious problems and lost life in critical conditions, Hence to overcome these problems the new Patient Health Monitoring System (PHMS) was proposed to monitor and evaluate the status of each patient by the doctor even in their absence in hospital or near the patient.

Eugster et al. (2009) They proposed a subscribe model that demonstrates the interaction between a publisher and a subscriber based on notification of an event. This work was considered to form the basis of integrating sensor nodes in a cloud environment, as it focused on data transfer between dissimilar entities of a system. Hassan et al. (2008) projected the challenges normally encountered while integrating WSN with cloud. The work proposed a sensor-cloud framework focusing mainly on Software-as-a-Service (SaaS) applications. The work also proposed a scheme called Statistical Group Index Matching, which was used to transfer data to cloud applications, and evaluates it to exemplify its remarkable performance, as compared to the existing algorithms.

III. PROPOSED WORK

IoT-Cloud networks result from the convergence of distributed cloud networks and the IoT. These can take advantage of the ubiquitous sensing capabilities of the IoT and the virtually unlimited computing resources of the Cloud to offer a new class of services that create augmented information from the cloud-based analysis of IoT-based data. In IoT-Cloud networks, sensors, smartphones, connected vehicles, are not simple endpoints, but smart sensing, storing, and computing resources that can be jointly orchestrated with the rest of the cloud infrastructure. In this new paradigm, and the recent advances in network functions virtualization (NFV) and software defined networking (SDN) technologies, service functionality can be dynamically allocated across the resulting highly distributed platform and flows can be routed through the appropriate service functions in order to maximize end devices battery life, optimize service performance, and minimize overall operational cost. After describing the suitability of IoT-Cloud networks for the delivery of IoT services in future smart environments, the mathematical network and service models used to optimize the distribution of IoT services over IoT-Cloud networks was introduced.

The architecture of IoT contains three phases; they are collection phase, transmission phase, utilization phase. Body Area Network (BAN) is constructed to collect the required data from the patient. The parameters used to diagnose the disease may vary from one disease to another. Therefore each parameter is sensed by separate IoT devices which are connected to the patient. All the devices connected in the body of the patient are known as BAN in the data collection phase. Blood pressure module, heart rate monitor, temperature etc. are the basic devices used to collect the blood pressure, heart rate and temperature of the patient. The data collected in the collection phase is communicated to the doctor to evaluate the parameter for diagnosis.

Drawbacks of existing system

- ✓ Data prioritization is not applied for critical data.
- ✓ Due to the continuous operation of both cloud and IOT devices the resources may drain in short time.
- ✓ Data storage does not preserve the scheduled data(FIFO).
- ✓ Processing latency is high compare to the direct transmission model
- ✓ Scheduling of data is applied by validating the information regarding the passive monitoring

This system performs the following connectivity method to execute the Human machine interaction and second one is multidisciplinary optimizations which is formed in the many operations on the system architecture. The third one is managing the applications by the database and class mapping in the knowledge base.

The Human machine interaction can be achieved by the base of the resources and human, like doctors, nurse and patients are the human related resources and devices such the RFID, ambulance, medical resources are the interact to the human resources. Second, Multidisciplinary optimizations which is used to perform the design of the automated design methodology and the major role in the system architecture, because it creates the all strategy of the system and also to provide the prescription to patient automatically.

Managing applications is used to manage all the resources and the patients records also. The patients records also maintained by classes and sub classes. In application management also performs the design collaboration, information and application integration based on the database and the knowledge base in the system.

For instance, in smart grids, the data collected by smart meters can be pre analyzed at the edge of the network reducing the amount of data sent to cloud data centers, saving both computing and transport resources, and significantly reducing service latency. In smart mobility services, the analysis of data collected at the edge of the network can significantly increase responsiveness to sudden events, such as vehicle collisions, improving the efficiency and safety of transportation networks. In smart buildings, while centralized cloud resources can be used for complex data analysis, edge cloud nodes are ideally suited for low-latency real-time physical system control and actuation.

The sensing or data acquisition capabilities of end devices, such as sensors, video cameras or RFID tags, are considered. The capacities and energy costs of processing and transmission resources are modeled across the entire heterogeneous IoT-Cloud network, including core, metro, access, and end devices.

The reliability of links is considered in order to characterize the possible packet losses and associated retransmissions, particularly relevant in low power wire. the distribution of computing and storage resources close to the sources of information allows scaling the number of connected devices and services without saturating the transport network. A virtualization technology allows sharing the heterogeneous physical infrastructure among multiple services that can elastically tap into a rich pool of resources without the need of dedicated deployments.

The end-to-end latency is modeled by considering the delay contributions along the entire service path, from the nodes that generate the source data to the delivery of the final augmented information to the end users. The IoT-CSDP captures the unique nature of IoT services, typically characterized by a multicast upstream phase in which sensed data that can be used for multiple services and end users is uploaded to edge cloud nodes, and a typically unicast downstream phase in which specific information resulting from the processing of sensed data is delivered in a personalized manner to the end users.

IV. SYSTEM IMPLEMENTATION

The implementation setup has following modules to execute the operations of the critical data monitoring in the health care application.

- ✓ Infrastructure configuration using IOT-Cloud setup.
- ✓ Passive monitoring system including body temperature sensor and heart rate estimation.
- ✓ Establishing the connection with GSM module and Health care data reporting to the user.
- ✓ Critical event monitoring and energy monitoring of active sensor module.

Infrastructure Configuration Using Iot Cloud Setup

- ✓ Creating the web server and Configuring the cloud server
- ✓ Deploying the sensor devices and establishing the connection with controller
- ✓ Maintain the login database in cloud server
- ✓ Establishing connection between WSN and Cloud model
- ✓ Creating the authentication model for user in cloud server

Considering a hierarchical IoT-Cloud network architecture composed of three main layers:

1. A Cloud layer, in which cloud nodes are organized into 3 tiers, i.e., a head office (HO) node representing the largest centralized data center, intermediate offices (IOs), and end offices (EOs)
2. an access layer, composed of base station (BS) nodes hosting micro-clouds (MCs) or cloudlets, and
3. a device layer, containing wireless sensors, smart devices (e.g., smartphones, tablets, smart glasses), and connected vehicles. The specific configuration of the IoT-Cloud network will be described for each of the simulated scenarios.

Passive Monitoring System Of Patient Health Status

- ✓ Activating the temperature and heart beat sensor using controller module.
- ✓ Read the analog input from each sensor unit and normalize the raw value into each data units.
- ✓ Validate the input for upper and lower bound value in each periodical monitoring process

- ✓ Generate the report regarding the estimated sensor input values

The system has to process the application level monitoring by means of the first application scenario, assuming that the mobile user accesses the mobile application with a cycle. For each cycle, the mobile application is accessed from every 1 minute to every 5 minutes and there are total 6 accesses. For the second application scenario, we make the mobile user utilize the cloud application also with a cycle. In this cycle, mobile user accesses the mobile application according to a parabola with maximum every 5 minutes and minimum every 1 minute. There are total 10 accesses for this cycle. With respect to the last application scenario, the mobile user utilizes the mobile application with a random interval between 1 minute and 10 minutes. The track of the mobile user is observed and recorded to obtain a database which contains the current locations of mobile users and the mobile user location list. In terms of communication technologies, cloud nodes and base stations are connected via optical links, smart devices use cellular or WiFi, and wireless sensors communicate using the ZigBee protocol.

Healthcare Data Reporting And Gsm Module

- ✓ Validate the connection between sensor controller and GSM module.
- ✓ Report the generated data to the cloud server.
- ✓ Retrieve the authority information including the doctor, caregiver and hospital server for log maintenance regarding the patient from the patient information database
- ✓ Create an alert message to the authorities with the corresponding information about the patient health status.

Pre-recorded ECG signal data from a database are used to demonstrate the feasibility of simultaneous sensor data collection, data display, and relaying data to a central server using the smartphone. To provide two way communication cloud system is used. Here Real Time Health Portal stores all the data that has been sensed by sensors for that MS-SQL database server is used.

For the user interaction this data are visible into Android app which is written in JAVA Programming Language. This app can be installed on Android mobile, PC, Tablet, Laptop. So user can view the data in real Time. To complete the path Ethernet Shield is used which provides Internet Connection and sends data in real time in database.

Priority Based Critical Event Scheduling

- ✓ Along with the periodical monitoring, validate the data for critical events.
- ✓ Prioritize the critical event based on the critical status about the patient.
- ✓ Create the schedule by validating the priority information.
- ✓ Transmit the data using the schedule created based on the priority of the critical event.
- ✓ Perform the energy monitoring of the sensor unit and generate the report to the health care authorities.

The WI-FI protocol supports multiple concurrent connections up to 7 different nodes. This emphasizes the ability to connect multiple sensor nodes simultaneously without interrupting other data collection processes. In this paper, a multiple WI-FI connection method is used which connects to different sensors and commits data transfer on-demand when an anomaly is found on that particular sensor. Since neither the ESP nor WI-FI connection interferes with each other, new WI-FI MAC address information using an ESP tag can be obtained at any time even during WI-FI data transmissions. Registering a new MAC address to the Android system immediately connects to the sensor node, but does not begin data transfer until a request is initiated by the sensor. The WI-FI protocol is designed such that the server node maintains communication with up to 7 different devices and can also manage data transfer concurrently.

However, the current system avoids massive multiple WI-FI data transfers because through this arrangement, the Android system resource of the smartphone becomes available for stabilizing smartphone system operations. As an example, two different accelerometers are used in this study to illustrate the connection transition from one node to the other, as shown in Figure 12. For proper communication, the smartphone must be programmed to recognize the data type prior to interpreting the incoming sensor data. This can be achieved by identifying the WI-FI MAC address information on the sensor, having the ability to determine the information about the sensor data type. Considering the same number of Wi-Fi and cellular users, and an average number of 4 users simultaneously requesting the same information in total. Note that the sensor readings can be sent via multicast, since they can be used to generate different final information objects. However, personalized information can be sent via multicast only when multiple users request the same information at the same time. Otherwise, these must be sent via unicast. Nevertheless, we assume that the transmission from the base stations to the end users is always unicast, as neither Wi-Fi nor cellular multicast technologies are yet commercially available. As we can observe, if users request a low bitrate the IoT-Cloud solution tends to consolidate the processing functionalities at the HO in order to reduce the total processing cost.

This part contains the sensor which is LM35 analog temperature sensor, heart beat sensor and microcontroller Arduino Uno AT mega 328P. This block will sense the data and then data acquisition process is done. Then processed latest real-time data is transferred to the HLK-RM04 Serial to WiFi Module for further processing. Now, by using the real health portal user can have access to the database and can view the data. In this system Android App is used which is written in JAVA language that provides the access to the database, so that user can view data anytime anywhere. This app can be installed in Android mobile, tablet, PC and laptop. Here if data is abnormal then notifications goes to user mobile and also mail can be deliver to the care taker or health care provider.

Here two sensors are connected to Arduino Uno, temperature sensor, which measures the temperature of patient's body. And its output is in digital form. and Heartbeat sensor which measures heart rate of patient's body. This sensor is connected to Arduino Uno which is further connected to ESP Wi-Fi Module which provides serial communication. Then data is transferred to SQL database. This stores real time data and provides accessibility for data. Here IoT plays its roll, which connects two objects, here sensors and high-end and low-end computational devices like Desktop and mobile respectively. User can view that data into Android Application.

V. CONCLUSION

A smart medical service layer is directly linked to professional medical facilities such as hospitals, emergency centres, and medicine supply chain. For example, doctors can efficiently manage a large group of patients. The medical resource management layer works as a transition auxiliary layer, which involves the administration and management of medical resources in an efficient manner and facilitates the smooth operation of the iHome system. In this layer, cloud computing and services are available to health and life science providers, providing an efficient way for data security and patient privacy protection. The sensor data collecting layer is the basis of the entire network. It consists of data sensing and acquisition devices, local computing and processing units, data storage devices, and wired/wireless transmitting modules. It is a multi-standard wireless sensor platform, compatible with different wired/wireless protocols, such as Ethernet, RFID, Zig bee, Wi-Fi, Bluetooth, and 3G/cellular network.

VI. REFERENCES

[1]. G. Fortino and P. Trunfio, "Internet of things based on smart objects: technology, middleware and applications," Cham, Switzerland: Springer, 2014.

[2]. I. Lee and K. Lee, "The internet of things (iot): Applications, investments, and challenges for enterprises," Business Horizons, vol. 58, no. 4, pp. 431–440, 2015.

[3]. F. Cicirelli, G. Fortino, A. Giordano, A. Guerrieri, G. Spezzano, and A. Vinci, "On the design of smart homes: A framework for activity recognition in home environment," Journal of medical systems, vol. 40, no. 9, pp. 1–17, 2016.

[4]. P. Gope and T. Hwang, "Bsn-care: a secure iot-based modern healthcare system using body sensor network," IEEE Sensors Journal, vol. 16, no. 5, pp. 1368–1376, 2016.

[5]. E. Jovanov and A. Milenkovic, "Body area networks for ubiquitous healthcare applications: opportunities and challenges," Journal of medical systems, vol. 35, no. 5, pp. 1245–1254, 2011.

[6]. R. Gravina, P. Alinia, H. Ghasemzadeh, and G. Fortino, "Multi-sensor fusion in body sensor networks: State-of-the-art and research challenges," Information Fusion, vol. 35, pp. 68–80, 2017.

[7]. C. C. Poon, B. P. Lo, M. R. Yuce, A. Alomainy, and Y. Hao, "Body sensor networks: In the era of big data and beyond," IEEE reviews in biomedical engineering, vol. 8, pp. 4–16, 2015.

[8]. M. R. Yuce, "Implementation of wireless body area networks for healthcare systems," Sensors and Actuators A: Physical, vol. 162, no. 1, pp. 116–129, 2010.

[9]. G. Fortino, G. Di Fatta, M. Pathan, and A. V. Vasilakos, "Cloud-assisted body area networks: state-of-the-art and future challenges," Wireless Networks, vol. 20, no. 7, pp. 1925–1938, 2014.

[10]. G. Aloi, G. Caliciuri, G. Fortino, R. Gravina, P. Pace, W. Russo, and C. Savaglio, "Enabling iot interoperability through opportunistic smartphone-based mobile gateways," Journal of Network and Computer Applications, vol. 81, pp. 74–84, 2017.

[11]. M. M. Hassan, K. Lin, X. Yue, and J. Wan, "A multimedia healthcare data sharing approach through cloud-based body area network," Future Generation Computer Systems, vol. 66, pp. 48–58, 2017.

[12]. K. Sonoda, Y. Kishida, T. Tanaka, K. Kanda, T. Fujita, K. Higuchi, and K. Maenaka, "Wearable photoplethysmographic sensor system with psoc microcontroller," International Journal of Intelligent Computing in Medical Sciences & Image Processing, vol. 5, no. 1, pp. 45–55, 2013.

[13]. Y. H. Kwak, W. Kim, K. B. Park, K. Kim, and S. Seo, "Flexible heartbeat sensor for wearable device," Biosensors and Bioelectronics, vol. 94, pp. 250–255, 2017.

[14]. C. Vogt, J. Reber, D. Waltisberg, L. B¨uthe, J. Marjanovic, N. M¨unzenrieder, K. P. Pruessmann, and G. Tr¨oster, "A wearable bluetooth le sensor for patient monitoring during mri scans," in 38th Annu. Int. Conf. of Engineering in Medicine and Biology Society (EMBC), USA, 2016, pp. 4975–4978.

[15]. C. Seeger, K. Van Laerhoven, and A. Buchmann, "Myhealthassistant: An event-driven middleware for multiple medical applications on a smartphone-mediated body sensor network," IEEE journal of biomedical and health informatics, vol. 19, no. 2, pp. 752–760, 2015.

[16]. T. J. Voss, V. Subbian, and F. R. Beyette, "Feasibility of energy harvesting techniques for wearable medical devices," in 36th Annu. Int. Conf. of the IEEE Engineering in Medicine and Biology Society (EMBC), Chicago, USA, 2014, pp. 626–629.

[17]. W. Y. Toh, Y. K. Tan, W. S. Koh, and L. Siek, "Autonomous wearable sensor nodes with flexible energy harvesting," IEEE sensors journal, vol. 14, no. 7, pp. 2299–2306, 2014.

[18]. R. Hamid and M. R. Yuce, "A wearable energy harvester unit using piezoelectric–electromagnetic hybrid technique," Sensors and Actuators A: Physical, vol. 257, pp. 198–207, 2017.

[19]. M. Magno, D. Brunelli, L. Sigrist, R. Andri, L. Cavigelli, A. Gomez, and L. Benini, "Infinitime: Multi-sensor wearable bracelet with human body harvesting," Sustainable Computing: Informatics and Systems, vol. 11, pp. 38–49, 2016.

[20]. A. Dionisi, D. Marioli, E. Sardini, and M. Serpelloni, "Autonomous wearable system for vital signs measurement with energy-harvesting module," IEEE Transactions on Instrumentation and Measurement, vol. 65, no. 6, pp. 1423–1434, 2016.