Journal of Artificial Intelligence and Capsule Networks (ISSN: 2582-2012)
www.irojournals.com/aicn/

Smart Medical Nursing Care Unit based on Internet of Things for Emergency Healthcare

S. Ayyasamy

Professor, School of Computer Science and Engineering, REVA University, Bangalore, India

E-mail: ayyasamyphd@gmail.com

Abstract

Recently, the development and integration of various sensor control with smart intelligent unit is used in medical field through IoT. However, there is still a lot of space for growth in the medical and health industry's use of new technology. The traditional nurse care unit is managed through medical staffs, and the expanding medical demands creates the hospital's patients records to be updated inefficiently. Since this is now an urgent need, developing a realistic, smart medical nursing care unit at low cost with a system capable of facilitating the effective and convenient administration of medical staff has taken a new significance. The proposed framework, conducted in the analysis to monitor medical records and activities of the emergency care unit patients, functions as a nurse and gives patients the nurse care satisfaction. The patients' actual location may be obtained for the first time by cloud computing based smart system. The precise location of the patient is critical to rescue the patient in emergency situation. This research work illustrates that the intelligent nurse care unit is the main phase called Smart Medical Nursing Care (SMNC). It contains several sensor units and by the combination of many sensors in the sensor module, it takes very less reaction time to connect or communicate both sides i.e., between patients and medical staffs.

Keywords: IoT, Smart medical care, Zigbee, global positioning system, LTE network technology, Web server.

1. Introduction

Today, as information technology continues to advance, people's material well-being have greatly increased, and so is the hospital's information construction. Hospital information systems and intelligent construction have shifted their focus to provide intelligent medical care as a new path and objective. The Internet of Things (IoT) has tremendously facilitated

DOI: https://doi.org/10.36548/jaicn.2021.4.003
Received: 05.09.2021, received in revised form: 30.10.2021, accepted: 15.11.2021, published: 26.11.2021

information and intelligent construction in the healthcare and medical areas. Internet of Things (IoT) technology in hospital medical care unit is troubled and investigates it in depth [1-5].

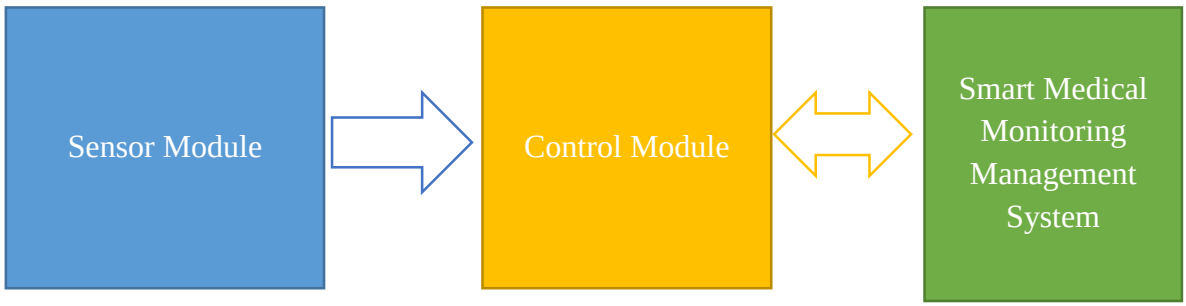

Figure 1. Smart Medical Monitoring Management System

At this time, most developed nations have begun to use the Internet of Things technology in the development of medical and health areas to promote medical and health system reform and offer the public intelligent healthcare services accessible at any time [6]. Personal healthcare, fitness, and activity monitoring gadgets are now accessible because of the growing interest in changeable sensors. Restoring, categorizing, and clinically accessing patient health information are all possible with remote health care monitoring systems. Education, finance, industry, entertainment, networking, shopping, and e-commerce are just a few of the numerous uses of the Internet. The Internet of Things (IoT) has emerged as the internet's newest megatrend. An internet of things is which detects, transmits, and exchanges information across a specific internet protocol or public networks, such as WiFi. A network of linked items collects, analyses, and uses data to plan and make decisions in real-time, offering a perceptive network for analyzing, planning and decision making. The output of the sensor module offers the information required to integrate control and monitoring management systems. As a general rule, the Internet of Things (IoT) involves connecting physical items to the internet and using them for remote monitoring [7-10].

Nursing aid through telemedicine is based on community medical care and family beds, which are the primary components of this concept. Technology that allows physicians and family members to monitor the patient's health in real-time and gives focused nursing care without having to be near the patient is becoming more common [11]. As a result of the illness's rise, present medical practices will be transformed, and disease prevention and detection will be improved. This innovative way of monitoring, enables the wireless access port to make the ward have more place for activities, which is more favourable to the creation of community and family medical care. At any moment, it is possible to set up the network, and its extension

is both easy and convenient. Patients and physicians may benefit from using a remote medical care monitoring system to better understand the patient's physical status [12-15].

The section 3 of this research article provides a list of previous studies on medical monitoring management systems for the purpose of security. Section 4 focuses on the proposed research that addresses the limitations of the previous studies. The results of the experiments are discussed in detail in Section 5. The final section of the proposal includes a discussion of the proposed project's output and its forward directions.

2. Related Work

Smart medical care is the subject of several researches both domestically and internationally. Smart medical nursing care unit for emergency is done with IoT based several sensors and control section [16].

The overall internal module link is combined with sensors. The smart medical hospital's information for medical care, in the current trend is by the development of hospital patients' records which are computerized. This procedure has introduced by Zuo and Yang Guoliang in the name of smart medical monitoring services with mobile application [17].

According to Costa et al., there are numerous ways to collect and integrate vital signs data in the hospital, including heuristic methods like weighted early warning systems with help of several algorithms through artificial intelligence. The accuracy improvement has been done through many optimizer algorithm and is compared with previous traditional studies [18]. Park et al. proposes the data acquisition system with the help of several abstractions of data techniques which is used to facilitate the creation of overall information from the patients' record [19].

It was suggested by Shao et al to fine-tune the prediction model by combining incremental learning with active learning. Remote health monitoring systems rely heavily on data capture, transmission, and cloud processing [20]. According to Moeen Hassanalieragh, ECG, body temperature, heart rate, and breath rate are some of the physiological characteristics that may be measured by wearable sensors. Short-range radio, such as Zigbee or low-power Bluetooth, is used to transport data from the receiver to the concentrator. As a result of the system's IoT-based design, each sensor's data may be retrieved through a concentrator via the internet. Storage, analytics, and visualization are all parts of the cloud processor [21].

2.1 Research statement

The research problem can be identified for intelligent medical services through IoT technology by the Smart Medical Nursing Care Unit (SMNC). The patient's records are placed on the hospital server and are not updated with any recent information from the doctor, which leads to dangerous treatment. Besides, the location of the emergency patients is not easy to identify during their needy zone. This research work proposes the smart medical nursing care unit idea to solve these problems with several units such as GPS, GSM, and Wi-Fi module.

3. Proposed Methodology

This proposed framework consists of 4 main parts namely,

1. Field Sensor Network for Health care (FSNH)
2. Data handling for communication (DHC)
3. Cloud Platform Interface (CPI)
4. Medical Monitoring Management System (MMMS)

There are four primary components of the system as it is currently envisioned. Data transfer and cloud processing are parts of the first module's components. A Raspberry Pi, an Arduino Uno, and a regulated power supply are all parts of the setup. Figure 2 shows first phase, that is sensor control part of the proposed framework of MMMS. The following is an explanation of the major components:

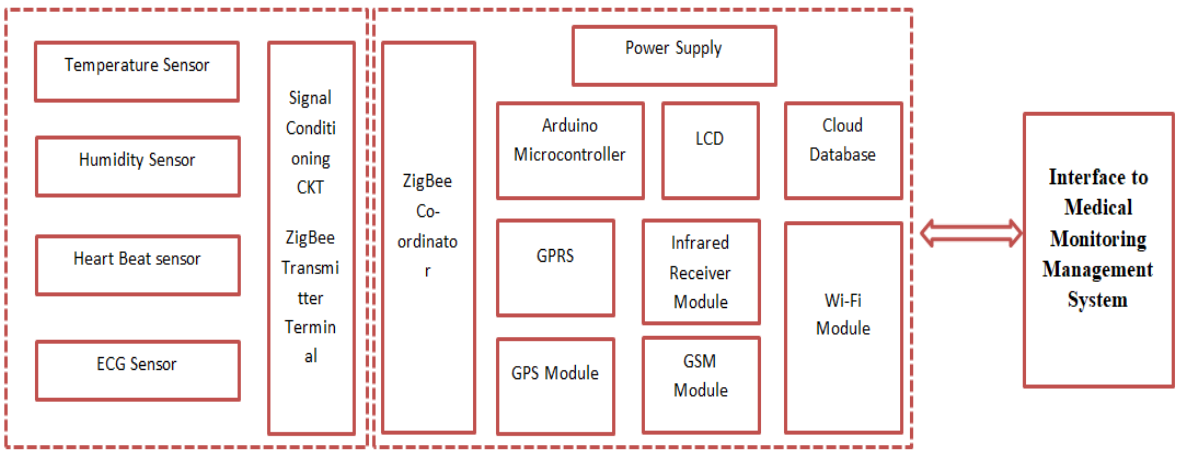

Figure 2. Proposed sensor control framework architecture for SMNC

3.1 Field Sensor Network for Health care (FSNH)

The cloud computing system should take this potential future evolution into account from the outset. Rather than a simple administration system, it will serve as a foundation for the deployment of associated applications. Users' and companies' future R&D enhancements will be built on top of this foundation. In remote locations without access to medical experts or vitals monitoring technology, patients' health data are collected manually. The patient must use the system to collect the data needed to make these conclusions about their health. Temperature sensors, heartbeat sensors, humidity sensors, and ECG are some of the sensors in the system that detects body temperature, heart rate, and ECG [22, 23].

The Raspberry Pi is a low-cost computer board that functions like a typical central processing unit. The microcontroller does not include an in-built Wi-Fi module or four USB ports. Various sensors, such as a temperature sensor, a heartbeat sensor, a humidity sensor, and an ECG sensor, are included in the proposed architecture depicted in Figure 2.

3.2 Data handling for communication (DHC)

The sensor data are sent sequentially to the cloud via UART. Only authorized medical practitioners have access to the information stored in the cloud. Each parameter's value is saved in the cloud individually. The alert message will be sent to the doctor if these parameter values are abnormal. The Wi-Fi module on the Raspberry Pi 3 picks up the sensor data and sends it to the cloud, where the doctor is alerted in the event of an emergency. Using the patient's password, the doctor may use the mobile app to see how the patient is doing.

An Arduino Uno is needed to convert sensor data from analog to digital before it is sent back to the Raspberry Pi, which can only accept digital data. Internet of Things wireless network technology consists of radiofrequency technology, infrared and IEEE 802.11b/a protocol technology, Home RF, ZigBee and GSM technology [24]. In comparison, the radio frequency (RF) technology is extremely well developed, the budget is inexpensive, and the absorptivity is excellent. If sensor resistance is not variable in the sensor, the conditioning circuit output will be compromised. The most critical shortcoming is the lack of a unified standard. Additionally, the communication protocols used by items from various firms are vastly different. Infrared technology has been around for a while, but it has to be linked to anything that can see it. This is excessively limiting and unsuitable for this kind of study in the traditional sense [25]. Figure 3 shows the next part of the proposed framework architecture.

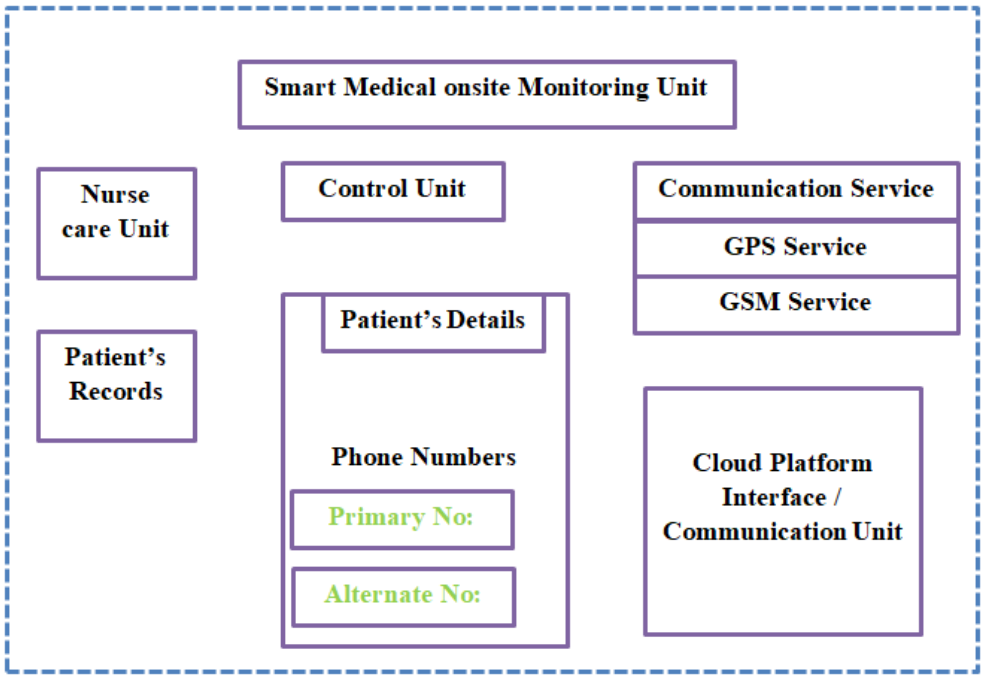

Figure 3. Proposed framework architecture for SMNC

3.3 Cloud Platform Interface (CPI)

The sensor's output information can be fetched and sent to the cloud using the Raspberry Pi microcomputer. In the event of a catastrophic event, the proposed system would send an alert message to both caregivers and physicians, paving way for immediate action. The cloud-based data can be accessed at any time and from any location by medical experts who have been granted permission to do so. The processing and storage capacity of the cloud may be expanded to meet the demands of individual applications [26].

3.4 Medical Monitoring Management System

Medical practitioners are able to access patient reports through the front-end application. This front-end application also alerts medical personnel to monitor important patients. They may access the program with a password and monitor the patient's condition and take fast action in the event of an emergency.

Using the UART (Universal Asynchronous Receiver/Transmitter), which is a computer hardware device for asynchronous serial connection; the sensor data is delivered to the cloud. The cloud platform interface unit is communicated through several services. Driver circuits

manage the electrical signalling levels and techniques that are not handled by the UART itself. Data bytes are taken and sent sequentially using this method [27-30].

4. Experimental designs for SMNC unit

A reputable hospital provided data of 30 participants for this study. Two groups of 15 people each were chosen and randomly split. The experiments told the experimental group that sensors were required, and the control panel and GPS location module were employed for the first time. With the patient's and his or her family's permission, GPS devices was used to pinpoint the patient's precise position. The control group will not be included in this experiment. The 3GPP standards organisation describes the projected IoT's coverage capabilities, which exceed current GSM and LTE networks by at least 20 dB [31]. The data transmission rate is higher than other methods due to use of LTE networks. Table 1 shows the performance measures of proposed MMMS.

Table 1. Monitoring management system performance measures

Methods	Accuracy	Efficiency	Power consumption	Response time	Several communication Devices	Data transmission Speed
Monitoring system Alone	High	High	Less	High	-Nil-	-Nil-
Feedback System	Moderate	Moderate	High	Moderate	GSM	low
Proposed MMMS	High	High	Moderate	Good	GPS, GSM, Wi-Fi	High

Emergency healthcare post operatives use Internet of Things and cloud computing technology to monitor and control patients' physiological signs in real-time, as well as upload and send information, perform real-time monitoring input from the nursing team, and so on.

The emergency unit patients are undertaken by the direct control of nurse care unit in many hospitals. The IoT ensures the 24 hours uninterrupted operation through this proposed framework operation. This allows them to replace the bottles immediately when needed, as well as ensure that patients receive the best possible care. Figure 4 shows the graph for performance measures of systematic monitoring and control methods.

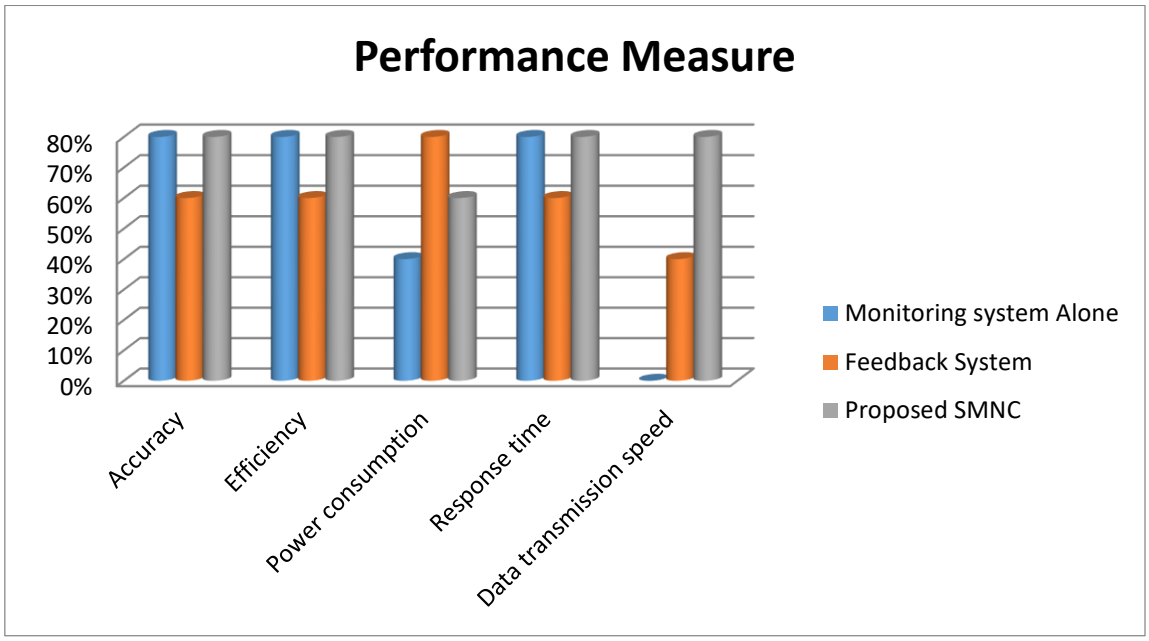

Figure 4. Performance measures of various methods

According to certain assessment objectives such as accuracy, efficiency, power consumption, response time, data transmission speed, the item is assigned an evaluation index, which might represent certain fundamental qualities of the assessed object. The index serves as a vantage point from which the objective is seen, since it is both precise and quantifiable. The proposed framework architecture is performing well enough in all other evaluation indices mentioned in table 1 that must be considered, in order to obtain conclusions. The gradual decomposition and refinement are linked in the assessment index system, which consists of three stages. The first and second-level evaluation indicators are the only ones that cannot be used directly as a foundation for assessment. The specific, quantitative, and behaviour-oriented assessment indicators are needed at the third level, and they may serve as the foundation for further evaluation.

5. Conclusion

The development of intelligent medical monitoring and management systems have gotten off to a late start in terms of scientific study. Medical Monitoring management systems have been installed on a number of large-scale structures in both developed and developing countries to assure the structure's regular performance while in use. This proposed algorithm is combined with GSM, GPS, and Wi-Fi module for fast data transmission process. The better reliable procedure for the medical monitoring management system is proposed here and is proved as shown in table 1. This proposed framework for smart medical nursing care units for

emergency healthcare includes real-time unit perception. The combination of cloud computing and smart medical monitoring architecture provides good data transmission time due to the LTE communication network. These services, which include home healthcare, emergency care in national highway, assistive care, telemedicine as well as in big medical resources, must be merged further in order to achieve a fully integrated IoT-based medical system. Work on safety problems related to the various stages of implementation is still needed.

References

[1] Raj, Jennifer S., and S. Jennifer. "Optimized Mobile Edge Computing Framework for IoT based Medical Sensor Network Nodes." Journal of Ubiquitous Computing and Communication Technologies (UCCT) 3, no. 01 (2021): 33-42.

[2] T. G. Li, “Research on data communication between intelligent terminals of medical internet of things,” in Proceedings of the Industrial Control Network and System Research Room, CSA2015, pp. 357–359, Wuhan, China, November 2015.

[3] Shakya, Subarna. "A Self Monitoring and Analyzing System for Solar Power Station using IoT and Data Mining Algorithms." Journal of Soft Computing Paradigm 3, no. 2 (2021): 96-109.

[4] F. Liu, Z. Chen, and J. Wang, “Intelligent medical IoT system based on WSN with computer vision platforms,” Concurrency and Computation Practice and Experience, vol. 36, p. e5036, 2018.

[5] Manoharan, J. Samuel. "A Novel User Layer Cloud Security Model based on Chaotic Arnold Transformation using Fingerprint Biometric Traits." Journal of Innovative Image Processing (JIIP) 3, no. 01 (2021): 36-51.

[6] Z. Pang, L. Zheng, J. Tian, S. Kao-Walter, E. Dubrova, and Q. Chen, “Design of a terminal solution for integration of inhome health care devices and services towards the internet-ofthings,” Enterprise Information Systems, vol. 9, no. 1, pp. 86–116, 2015.

[7] Dhaya, R. "Deep net model for detection of covid-19 using radiographs based on roc analysis." Journal of Innovative Image Processing (JIIP) 2, no. 03 (2020): 135-140.

[8] H. Shull, J. Friedman, C. Tymchuk, R. M. Hoffman, T. Grogan, and J. Hamilton, “Evaluation of the UCLA department of medicine Malawi global health clinical elective: lessons from the first five years,” the American Journal of Tropical Medicine and Hygiene, vol. 91, no. 5, pp. 876–880, 2014.

[9] Mugunthan, S. R. "Soft computing based autonomous low rate DDOS attack detection and security for cloud computing." J. Soft Comput. Paradig.(JSCP) 1, no. 02 (2019): 80-90.

[10] Z. Ni, I. Craddock, and T. Diethe, “Bridging e-health and the internet of things: the SPHERE project,” IEEE Intelligent Systems, vol. 30, no. 4, pp. 39–46, 2015.

[11] Sathesh, A. "Enhanced soft computing approaches for intrusion detection schemes in social media networks." Journal of Soft Computing Paradigm (JSCP) 1, no. 02 (2019): 69-79.

[12] O. Edafe, E. Cochrane, and S. P. Balasubramanian, “Reoperation for bleeding after thyroid and parathyroid surgery: incidence, risk factors, prevention, and management,” World Journal of Surgery, vol. 44, no. 4, pp. 1156–1162, 2020.

[13] Sungheetha, Akey, and Rajesh Sharma. "Fuzzy Chaos Whale Optimization and BAT Integrated Algorithm for Parameter Estimation in Sewage Treatment." Journal of Soft Computing Paradigm (JSCP) 3, no. 01 (2021): 10-18.

[14] K. G. Srinivasa, B. J. Sowmya, A. Shikhar, R. Utkarsha, and A. Singh, “Data analytics assisted internet of things towards building intelligent healthcare monitoring systems,” Journal of Organizational and End User Computing, vol. 30, no. 4, pp. 83–103, 2018.

[15] Manoharan, Samuel. "Early diagnosis of Lung Cancer with Probability of Malignancy Calculation and Automatic Segmentation of Lung CT scan Images." Journal of Innovative Image Processing (JIIP) 2, no. 04 (2020): 175-186.

[16] X. C. Zheng, Y. Sun, and G. J. Yu, “Ten key technologies of intelligent medical informatization based on internet of things,” Journal of Medical Informatics, vol. 34, no. 1, pp. 10–14, 2015.

[17] X. L. Zuo and G. L. Yang, “Research and practice of patient centered intelligent medical application model,” Journal of Medical Informatics, vol. 35, no. 12, pp. 13–18, 2014.

[18] C. A. da Costa, C. F. Pasluosta, B. Eskofier, D. B. da Silva, and R. da Rosa Righi, “Internet of health things: toward intelligent vital signs monitoring in hospital wards,” Artificial Intelligence in Medicine, vol. 89, pp. 61–69, 2018.

[19] Y. Park, J. Choi, and J. Choi, “An extensible data enrichment scheme for providing intelligent services in internet of things environments,” Mobile Information Systems, vol. 2021, Article ID 5535231, 18 pages, 2021.

[20] Y. Shao, Y. Zhao, and F. Yu, “The traffic flow prediction method using the incremental learning-based CNN-LTSM model: the solution of mobile application,” Mobile Information Systems, vol. 2021, Article ID 5579451, 16 pages, 2021.

[21] Moeen Hassanalieragh,Gaurav Sharma “Health Monitoring and Management using IOT sensing with cloud based processing” 2015 IEEE International on services computing.

[22] T. von Ahnen, M. von Ahnen, S. Militz et al., “Compartment pressure monitoring after thyroid surgery: a possible method to detect a rebleeding,” World Journal of Surgery, vol. 41, no. 9, pp. 2290–2297, 2017.

[23] Adam, Edriss Eisa Babikir, and A. Sathesh. "Construction of Accurate Crack Identification on Concrete Structure using Hybrid Deep Learning Approach." Journal of Innovative Image Processing (JIIP) 3, no. 02 (2021): 85-99.

[24] B. C. Brajcich and C. R. Mchenry, “The utility of intraoperative nerve monitoring during thyroid surgery,” Journal o[f Surgical Research, vol. 204, no. 1, pp. 29–33, 2016.

[25] Mugunthan, S. R. "Soft computing based autonomous low rate DDOS attack detection and security for cloud computing." J. Soft Comput. Paradig.(JSCP) 1, no. 02 (2019): 80-90.

[26] H. Hamidi and M. Jahanshahifard, “The role of the internet of things in the improvement and expansion of business,” Journal of Organizational and End User Computing, vol. 30, no. 3, pp. 24–44, 2018.

[27] Kashyap, Neeti, A. Charan Kumari, and Rita Chhikara. "Service Composition in IoT-A Review." In International Conference on Intelligent Data Communication Technologies and Internet of Things, pp. 287-291. Springer, Cham, 2019.

[28] Srivastava, Meenakshi, and Rakesh Kumar. "An IoT Based Weather Monitoring System Using Node MCU and Fuzzy Logic." In International Conference on Computer Networks and Inventive Communication Technologies, pp. 126-137. Springer, Cham, 2019.

[29] Paulraj, Getzi Jeba Leelipushpam, Immanuel JohnRaja Jebadurai, Jebaveerasingh Jebadurai, and Nancy Emymal Samuel. "Cloud-Based Real-Time Wearable Health Monitoring Device Using IoT." In Computer Networks and Inventive Communication Technologies, pp. 1081-1087. Springer, Singapore, 2021.

[30] Sreelekha, M., Ganesh Gopakumar, and K. Shahil. "IoT-Based Water Quality Monitoring System Using LoRaWAN." In Computer Networks and Inventive Communication Technologies, pp. 1157-1170. Springer, Singapore, 2021.

[31] George, Anjana, Anu S. Alunkal, Gopika G. Nair, and Poornasree R. Mohan. "Privacy Protection and Con Dentiality in Medical IoT." In International Conference on Computer Networks and Inventive Communication Technologies, pp. 21-27. Springer, Cham, 2019.

Author's Biography

S. Ayyasamy obtained his Bachelor's degree in Electronics and Communication Engineering from "Maharaja Engineering College, Avinashi" under Bharathiyar University and Masters Degree in Computer Science and Engineering from "PSG College of Technology, Peelamedu, Coimbatore." under Bharathiyar University. He completed his Ph. D in the area of Peer to Peer Overlay Networks under Anna University, Chennai. He has 19 years of teaching experience. He is currently working as Professor in the School of Computer Science and Engineering at REVA University, Banglore, India.. He has been working as Reviewer for reputed journals like Human-computer Interaction journal -Taylor & Francis, Journal of Network and Computer Applications–Elsevier and Information Security Journal-Inderscience. He was also working as the Editor for International journal of Engineering Technology and Science. He was acted as coordinator for the Establishment of New Course B. Arch and Information Technology lab, for conducting Info science microsoft conference RACHNA'09, for the Recognition of Anna University Research Center, to start a new journal entitled "International Innovation Journal of Engineering and Applied Research" through SRDC, Infosys Campus Connect Assistant Coordinator and many more prestigious activities. His Research areas of interest are Peer to Peer Networks, Overlay Networks, Automation, Machine learning and Artificial Intelligence.