Smart Hospital Setups with IoT-Enabled Connectivity of Artificial Intelligence System

Vella Satyanarayana[1,*,†], Mahesh Kumar Singh[1,†] and Robin Varghese[1,†]

[1]Department of ECE, Aditya Engineering College, Surampalem, India

Abstract

The widespread of the internet of things (IoT) like sensors, actuators, wearable devices play a vital part in our daily lives as well as it will mainly help in hospitals also. It improves the quality of our life. It also improves the quality of medical care and it improves the facilities in hospitals. We need an architecture that connects all the intelligence of things that are made feasible in hospitals by Narrowband intelligence of things (NB-IoT). Here proposed the architecture that is connected by the intelligence of things based on NB IoT. IoT develops many various applications to support Wi-Fi and additional data gathering approaches which probably collects the data and transfers the information to a cloud stage. It processes to a secure connection that increases the users in the real-time interface. It implements the structure of the design and made a small demonstration design and it tests the results. It develops a smart grid in our lives.

Keywords

IOT, NB-IoT, Smart grid, Sensors, Actuators, Cloud platform

1. Introduction

As we know there is rapid use of the internet, the IoT, and wearable devices. many hospitals have put it into implementation like they use mobile applications for a doctor appointment, online consultancies,3G blood pressure meter, smart ECGs and many more [1, 2, 3]. These devices are known as monitoring devices i.e. monitoring devices will send the information to A framework for short- and long-range wireless connections between autonomous entities. The support of modern technology like IoT and cloud computing it had created a smart grid around us. By using IoT it results in rapid digitalization across the hospitals. This technology follows up and connects with everyday objects such as sensors, actuators, and many more to the IoT and increases the efficient use of hospital resources. We had a network that will monitor the environment of the hospital with the NB-IoT [4, 5, 6]. For instance, there is a network architecture for tracking patients' behavior and environment in hospitals.

- we use the IoT smart gateway.

ACI'23: Workshop on Advances in Computational Intelligence at ICAIDS 2023, December 29-30, 2023, Hyderabad, India

*You can use this document as the template for preparing your publication. We recommend using the latest version of the ceurart style.

*Corresponding author.

†These authors contributed equally.

vasece[underscore]vella@aec.edu.in (V. Satyanarayana); mahesh.092002.ece@gmail.com (M. K. Singh); 20A91A04O4@aec.edu.in (R. Varghese)

- It provides the data from terminals of smartphones using networks like 4G and 5G.
- NB-IoT is a smart protocol that works virtually everywhere.

Application scenarios: Tele-medicine monitoring: Patients who have been discharged from hospitals are required to undergo thorough monitoring in their homes. We are able to monitor or examine the patient's conditions, even when such situations are atypical, thanks to the use of wearable equipment [7, 8]. Therefore, the device notifies the members of the family, allowing them to instantly make a trip to the physician [9]. Intelligent parking: Intelligent parking means we can book our parking slot before going to the hospital. We can book parking slots using mobile apps it will lock our parking slot until we arrive when we leave the hospital it will auto-lock our slot using wireless communication [10, 11]. **Access Control:** Access control means giving control to the staff of the hospital so when they arrive it will give control and open the door using wearable devices. **Other Applications:** By using sensors wireless devices and other networks they will help us to generate many facilities in hospitals and Medicare hospitals. For example, water meters in hospitals [12]. As the number of people in the world continues to rise, the healthcare sector is facing an increasing number of challenges. Following an intensive review of the relevant literature, it was found that the most prevalent issues that are related with healthcare include inadequate communication methods, insufficient staffing, poor patient flow, and lengthy hospital stays. These are the most common concerns. In point of fact, there is a necessity to address these concerns, and that is precisely what the objective of this effort is to do. When it comes to the internet of things (IoT), the most significant concerns for developers are not only the availability of resources but also the quality of security and the networking. The combination of this factor with the possibility of basic impediments results in a significant number of difficulties being encountered [13, 14].

A smart city is one that designs and implements smart solutions in order to create an environment that is more conducive to positive outcomes. Smart cities are designed and implemented when populations rise. In order to ensure that we maximise our productivity, it is absolutely necessary that we have a solid healthcare sector. Because of this, people will be able to perform their jobs with a level of worry that is much reduced. The plan that T. Alizadeh developed for a smart city includes a patient record system that is integrated with a variety of healthcare applications and is equipped with Internet of Things (IoT) devices and machine learning (ML) protocols. Additionally, the plan calls for the integration of these technology components. The technology and architecture of remote health monitoring (RHM) include a patient record system that integrates well with the appropriate sensing mechanisms and collects structured and unstructured data for machine learning analysis [15].

RHM is also known as remote health monitoring. There is another name for RHM, which is remote health monitoring. In order to facilitate the transmission of data and signals across the various devices, systems, and models that make up the Internet of Things, communication protocols have emerged as an indispensable component. The individuals who live in smart cities are afforded a good quality of life as a result of their residence. Blockchain technology has the potential to be advantageous for smart cities because it enables the storage of transactions in a ledger that is not only safe but also open, shared, and immutable within the network. It is possible to categorise the technologies that constitute the communication systems of the smart city as follows: proximity wireless, personal area networks, wireless local area networks,

wireless metropolitan area networks, and wireless wide-area network technologies. Numerous technologies, such as radio-frequency identification (RFID), Bluetooth, near field communication (NFC), 3G, 4G, 5G, Zigbee, and others, all comprise them. Among these technologies are also others [16, 17].

Because of the rapid development of edge-assisted solutions in Internet of Things (IoT) networks, connected healthcare is becoming increasingly dependent on these solutions. This is because edge-assisted solutions are extremely useful. This is a reference to the systems that are in place to ensure that all of the various players in the healthcare business are connected to one another. Some of the cutting-edge technologies that are utilised by these systems include the Internet of Things (IoT), edge computing, and artificial intelligence (AI) [13]. These technologies are utilised in order to change conventional health care systems into intelligent systems that are more effective, appropriate, and individualised. On the other hand, such systems are subject to a significant number of restrictions and require innovative regulations to be implemented. Fog computing is transformed into edge computing by the process of moving computation and processing closer to the data sources and end-users [18]. Edge computing has the ability to reduce latency, bandwidth utilisation, and energy consumption [19] expenses. Fog computing is also known as fog computing. To the best of our knowledge, there is no research that is both methodological and systematic, and that examines the studies that have already been conducted while taking into consideration a wide range of factors that are significant and relevant [20]. Within the scope of this survey, the objective is to investigate the most recent research that has been carried out in this particular field. After completing an in-depth examination of a significant number of papers that deal to this topic, we have categorised them into two basic taxonomies: approaches that are process-centric and procedures that are patient-centric. In addition, key issues, such as the data sets that are readily available, as well as parameters like as accuracy, mobility, and data rates, are discussed and studied [21, 22, 23, 24]. Our goal is to bridge the gap between edge computing and linked healthcare solutions by participating in a discussion of the difficulties that may arise in the future and by conducting an evaluation of the trends that may emerge in the following years [15].

2. Related Work

In this paper, we are discussing the usage of IoT in hospitals for solving or detecting problems in hospitals. In hospitals, there is excessive usage of electricity so using Arduino board equipped with micro-controller which has low power utilization. In this paper, we discussed the construction and architecture with the combined implementation of IoT in smart hospitals.it provides a concrete application scheme and changes the existing hospital model into a smart hospital. In this research, the IoT and artificial intelligence are used to create a smart and safe framework for the hospital environment. With the assistance of AI, it controls the use of a wide variety of electronic components, including actuators, sensors, and more. The Internet of Things and artificial intelligence working together will bring further benefits to many different industries [1, 25, 18].

This paper contains information about the introduction of the system's design, architecture, and test results, both simple and complex. It develops an IoT system that is very much required in

hospitals for various requirements [20, 21]. The authors of this piece of writing presented the idea of a "smart community," which is characterized by its use of the Internet of Things. In the subject of cyber-physical systems, the communal networks of interconnected and communicative electronic devices are referred to as "smart communities." It encourages a scenario in which embedded sensors and actuators can self-configure and be controlled through the internet; this topic will be deliberated in greater details in the approaching units of this article [2, 3, 4].

The use of tele-medicine and remote patient monitoring is becoming increasingly significant as a means of avoiding physical contact with patients. The Internet of Things (IoT) and the technologies that are connected to it, such as Artificial Intelligence (AI), Machine Learning (ML), Blockchain technology, and Cloud Computing, are the resources that make this a reality. Due to the fact that the Internet of Things (IoT) generates such a substantial amount of data in a wide range of forms, there is a substantial demand for connection and streaming analytics. Because of this, the 5G technology and its applications have been taken into consideration. These applications include smart 5G connected ambulances and hospitals that are based on 5G technology. A further potential technology is long-range radio, which is becoming the technology of choice for Internet of Things networks all over the world, particularly in regions with inadequate network coverage [6, 7, 15].

This is due to the fact that long-range radio operates with a low amount of power and has the ability to transmit data over long distances at faster speeds. In view of the fact that there is a lack of suitable medical infrastructure all over the world, an evaluation of smart ventilators that are based on the Internet of Things has simultaneously been carried out. This is because there is a demand for qualified medical staff as well as ventilators in the modern medical field. A smart healthcare model design is suggested as a potential solution to the problem of Internet of Things (IoT) problems in the healthcare business at the conclusion of the paper. This model design is proposed as a potential solution. The module also includes a UVC Disinfection box, which would be of tremendous assistance in removing the chance of the virus infiltrating our homes. This is in account of the current state of events about the COVID-19 Pandemic, which is currently prevalent [8, 9, 16].

As an additional point of interest, the rapid use of blockchain technology results in a significant contribution to the formation of a new ecosystem for digital smart cities. Therefore, the confluence of blockchain technology with artificial intelligence technology is revolutionising smart city infrastructures in order to establish sustainable ecosystems for Internet of Things applications. This is a result of the convergence of these two technologies. However, these technological innovations and advancements in technology also generate opportunities and issues for the creation of applications that are sustainable for the Internet of Things. These opportunities and problems affect the development of applications. Blockchain technology and artificial intelligence are a singular force that is pushing technical innovation in applications that are both intelligent and sustainable for the Internet of Things [7].

The purpose of this essay is to study the confluence of these two technologies. During our chat, the primary focus was on the potential advantages of blockchain technology, which has the ability to support the creation and development of Internet of Things applications that are ecologically friendly. We were able to introduce a conceptual framework that is both clever and sustainable thanks to the conversation that served as the basis for our presentation. The processing and acquisition of the necessary information is accomplished by this framework

through the utilisation of cloud computing, devices connected to the Internet of Things, and artificial intelligence. The system provides digital analytics and keeps the data in decentralised cloud repositories utilising blockchain technology. This is done with the intention of supporting a wide variety of applications. Furthermore, the layer-based design makes it possible to have a sustainable incentive structure, which may be of aid in the development of smart city applications that are secure and protected. This is because the design is built on layers [8, 9]. In this section, we discussed the enhanced solutions and provided a summary of the most essential components that may be utilised for the construction of a variety of systems that are based on blockchain technology and artificial intelligence. In addition, we discussed the issues that have not yet been resolved as well as our future research objectives, which may result in the creation of novel ideas and future standards for applications of the Internet of Things that are accountable for the environment [12, 25].

It is a conceptual paper we learn deficiencies of the IoT concept and how to analyze them and to discover the issue behind the lack of reasoning and IoT concept.it concludes the benefits of implementing a concept to solve real-world issues and solves a lot of issues and eases our daily routine. The introduction of the IoT technology is followed by a suggestion for the creation of a sensor system based on IoT gateways in this study [5, 6]. It concludes that in order to achieve the information storage for sensor access, it has created an LAPD environment. This paper used the IoT to build a real-world scenario of smart hospital management. It seeks to describe in detail the technologies underlying the IoT and the modeling of health care data for medical devices [8]. As IoT is gaining momentum for many devices and wireless systems soon be adopting various IoT technologies. In IoT, every device is connected to the internet. It provides a brief survey to security threats extent change to different IoT devices [10, 11].

3. Method and Methodology for Image Detection HELM-FSK

The NB-IoT standard is particularly designed for usage in low-power, stationary, heavily-loaded applications with little tolerance for delay. The communication delay cannot be tightly controlled with the NB-IoT protocol. The protocol was created with the network design in mind, which demands for a lot of access points and a low minimum power consumption requirement. In some use cases for smart hospitals, such as the intensive care unit where specific physiological sign data of patients with serious conditions must be uploaded in real time, requiring a low latency, this could be a concern shown in figure 1. Using NB-IoT in smart hospital has a number of benefits, including the following:

- NB-IoT has the potential to facilitate billion of connection and link tens of thousands of user in a single locality.
- It can effectively avoid the devices from accessing pseudo Bs.
- When compared to the already available mobile network, the link budget for NB-IoT is increased by about 20 dB

Here, classifying the authentic and the annoyance picture using a novel HELM-FSK has been proposed. The proposed techniques are the filter term with the median filter principle and the overlapping units are discussed before processing. The function vector is extracted

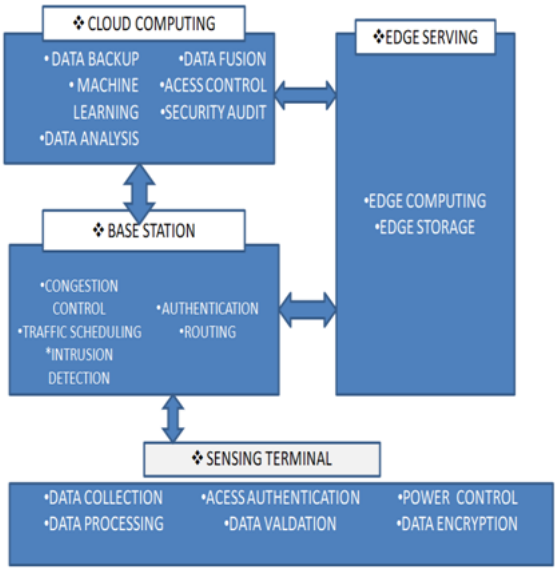

Figure 1: Proposed NB-IoT standard

from the area indicated by the object boundary detection. The wavelet transformation is also defined. With the use of this tool, the work expands the forgery detection. The similarities are calculated by DBA between vectors. The flow graph of this proposed method is characterized as demonstrated in figure 1.

- The clouds platform store and processed worldwide data with low latency requirements, and it uses big data analysis to maintain control.
- A huge number of NB-IoT base station is deployed in the BS layer. These NB-IoT base stations must be furnished with routing, congestion control, traffic scheduling, and data encryption systems in order to guarantee the smooth integration and security of data transfers.
- In the sensing layers, there are a significant number of terminals device that have NB-IoT modules embedded into them. Data collection and processing are two of the functions that these gadgets are capable of. attacked. The sensing layer needs to have security methods such as data encryption, data verification, and access authentication in order to maintain the confidentiality and safety of the data. Two-factor authentication is required for access authentication, which must involve both the devices and the BS.
- Because the edge server is located quite close to the terminal, the amount of time it takes for data to complete a round trip is relatively short, which significantly lowers the latency. The monitoring that takes place in intensive care settings, for example, has a high requirement for latency, and this can be of considerable help to that monitoring.

We have integrated the Internet of Things into our platform. The five levels that make up this system are the sensing layer, the forwarding layer, the connection layer, the data storage

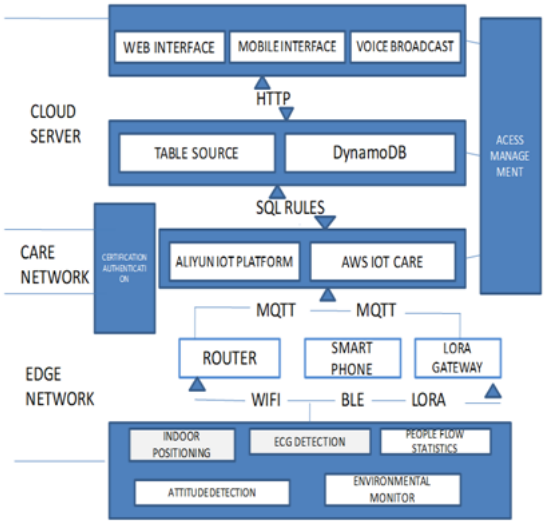

Figure 2: NB-IoT access method

layer, and the service layer. Each succeeding layer now has a name that accurately describes the task it is responsible for carrying out. The sensing layer integrates support for a wide range of wireless Internet of Things protocols in order to gather information. Heterogeneous data from various devices will be treated uniformly at the forwarding layer before being delivered to the cloud over a secure connection at the connection layer. Once the information reaches the data storage layer, it will be permanently archived. This data is once again made available to the user through the user interface that the service layer offers shown in figure 1.

In figure 2 shown that it links networks and smart sensors. ”Smart” healthcare, ”smart” housing, ”smart” grids, and other fields employ the Internet of Things. A growing number of governments are developing ”smart healthcare” pilot projects. Edge computing could help IoT-enabled healthcare systems secure equipment and patient data. IoT-enabled healthcare delivery systems also need edge computing. Edge computing offers low-latency, low-cost data services. The technology improves healthcare IoT devices' connectivity and processing speed. Authorization of IoT devices is required prior to data transmission in IoT-enabled healthcare systems. In order to swiftly process the authenticated data, it must be offloaded to powerful computers at the edge. With the help of the SDN controller, which can create complete network programmability, offloading to the Edge can be done in a planned manner. SDN's smarts are what meet the needs of Edge computing in terms of load balancing and allocating resources, while a lightweight authentication method safeguards the security of sensitive information. The SDN controller is in charge of handling data, ensuring that time-sensitive data is handled properly, orchestrating the Edge, and ensuring that data flow is both fast and secure.

4. Results and Discussion

In this section, we simulate our design for safe healthcare systems to test its performance in real-world settings. Here, the simulations are run on a computer. First, we'll go over the simulation and testing setup, describe some key performance measures, and analyze the simulation's output in light of these and other considerations. MATLAB was used to analyze the proposed system's robustness, and the resulting data was put into our model. The SDN controller, Edge Server, and authentication protocol were all executed in parallel, but on separate simulated threads. The Edge server thread is responsible for load balancing and resource efficiency, while the authentication protocol thread is in charge of ensuring system security. Among the responsibilities of the SDN controller thread is the periodic analysis of trending network parameters. These settings allow you to fine-tune edge-to-gateway communication, edge-to-edge collaboration, and task transfer shown in table 1 and table 2.

Table 1
Parameter analysis of IoT in smart hospital

S. No.	Parameter	Parameter of IoT in smart hospital
1	Connection	Unified architecture to connect all IoT from smart hospital
2	NB-IoT Bandwidth	180 KHz
3	Latency	Using Edge computing for reduction
4	Power consumption	Low
5	Cost	Low cost
6	Real time requirement	For ECG
7	Mobility	NB-IoT set for non-mobility

Table 2
Parameter analysis

S. No.	Parameter	Parameter analysis
1	Environment	Relaying on digital environment
2	Network	Collaborative network to improve the efficiency, service capability, and flexibility between smart devices.
3	Privacy and security	Collaboration process for privacy and security
4	Complexity	Connecting of multiple devices in heterogeneous network
5	Large scale	Numbers of devices connected
6	Maximum signal rate	Rate of LAN, WAN

Healthcare systems with IoT capabilities should use edge computing with software-defined networks for security. Simple authentication verifies IoT devices' legitimacy. The Edge server

processes patient data following authentication. Each Edge server includes a separate SDN controller for intelligent decision-making and load balancing. SDN-based edge computing improves collaboration and resource use by optimizing network design. The network's reaction time, packet delivery ratio, latency, throughput, and control overhead are improved. Three independent simulations were conducted to verify the suggested method's efficacy. Protecting patients' personal and medical data is one of our future goals. We suggest recording data patterns in a dataset and using a machine-learning system to predict hostile network activity. Data encryption and decryption can begin after system configuration. Extensive testing has shown its effectiveness in encrypting and decrypting data at the sender and recipient.

5. Conclusion and Future Scope

Healthcare systems with IoT capabilities should use edge computing with software-defined networks for security. Simple authentication verifies IoT devices' legitimacy. The Edge server processes patient data following authentication. Each Edge server includes a separate SDN controller for intelligent decision-making and load balancing. SDN-based edge computing improves collaboration and resource use by optimizing network design. The network's reaction time, packet delivery ratio, latency, throughput, and control overhead are improved. Three independent simulations were conducted to verify the suggested method's efficacy. Protecting patients' personal and medical data is one of our future goals. We suggest recording data patterns in a dataset and using a machine-learning system to predict hostile network activity. Data encryption and decryption can begin after system configuration. Extensive testing has shown its effectiveness in encrypting and decrypting data at the sender and recipient.

References

[1] P. Kanase, S. Gaikwad, Smart hospitals using internet of things (iot), International Research Journal of Engineering and Technology (IRJET) 3 (2016) 1735–1737.

[2] K. Dhariwal, A. Mehta, Architecture and plan of smart hospital based on internet of things (iot), Int. Res. J. Eng. Technol 4 (2017) 1976–1980.

[3] M. R. Valanarasu, Smart and secure iot and ai integration framework for hospital environment, Journal of ISMAC 1 (2019) 172–179.

[4] B. Ç. Uslu, E. Okay, E. Dursun, Analysis of factors affecting iot-based smart hospital design, Journal of Cloud Computing 9 (2020) 67.

[5] X. Li, R. Lu, X. Liang, X. Shen, J. Chen, X. Lin, Smart community: an internet of things application, IEEE Communications magazine 49 (2011) 68–75.

[6] L. Yu, Y. Lu, X. Zhu, Smart hospital based on internet of things, Journal of networks 7 (2012) 1654.

[7] G. Veerendra, R. Swaroop, D. Dattu, C. A. Jyothi, M. K. Singh, Detecting plant diseases, quantifying and classifying digital image processing techniques, Materials Today: Proceedings 51 (2022) 837–841.

[8] U. Padma, S. Jagadish, M. K. Singh, Recognition of plant's leaf infection by image processing approach, Materials Today: Proceedings 51 (2022) 914–917.

[9] M. K. Singh, A text independent speaker identification system using ann, rnn, and cnn classification technique, Multimedia Tools and Applications (2023) 1–13.
[10] M. K. Singh, Feature extraction and classification efficiency analysis using machine learning approach for speech signal, Multimedia Tools and Applications (2023) 1–16.
[11] P. Pico-Valencia, J. A. Holgado-Terriza, D. Herrera-Sánchez, J. Sampietro, Towards the internet of agents: an analysis of the internet of things from the intelligence and autonomy perspective, Ingeniería e Investigación 38 (2018) 121–129.
[12] F. Hu, D. Xie, S. Shen, On the application of the internet of things in the field of medical and health care, in: 2013 IEEE international conference on green computing and communications and IEEE Internet of Things and IEEE cyber, physical and social computing, IEEE, 2013, pp. 2053–2058.
[13] C. V. Mani Kiran, B. Jagadeesh Babu, M. K. Singh, Study of different types of smart sensors for iot application sensors, in: Proceedings of Second International Conference in Mechanical and Energy Technology: ICMET 2021, India, Springer, 2022, pp. 101–107.
[14] V. Walia, V. Madaan, P. Agrawal, A. Mohan, C. Gupta, A. Sharma, A. Agrawal, Blockchain in iot and limitations, in: Trust-Based Communication Systems for Internet of Things Applications, John Wiley & Sons, Inc., 2022, pp. 17–27.
[15] M. K. Singh, S. Manusha, K. Balaramakrishna, S. Gamini, Speaker identification analysis based on long-term acoustic characteristics with minimal performance, International Journal of Electrical and Electronics Research 10 (2022) 848–852.
[16] A.-M. Rahmani, N. K. Thanigaivelan, T. N. Gia, J. Granados, B. Negash, P. Liljeberg, H. Tenhunen, Smart e-health gateway: Bringing intelligence to internet-of-things based ubiquitous healthcare systems, in: 2015 12th annual IEEE consumer communications and networking conference (CCNC), IEEE, 2015, pp. 826–834.
[17] P. Agrawal, V. Madaan, A. Sharma, D. K. Sharma, A. Agrawal, S. Kautish, Trust-based communication systems for internet of things applications, 2022.
[18] M. P. Kalyan, D. Kishore, M. K. Singh, Local binary pattern symmetric centre feature extraction method for detection of image forgery, in: International Conference on Artificial Intelligence and Data Science, Springer, 2021, pp. 89–100.
[19] S. Benedict, P. Agrawal, R. Prodan, Energy consumption analysis of r-based machine learning algorithms for pandemic predictions, in: International Conference on Advanced Informatics for Computing Research, Springer Singapore Singapore, 2020, pp. 192–204.
[20] K. Chandana Sri, Y. Deepika, N. Radha, M. K. Singh, Using convolution networks to remove stripes noise from infrared cloud images, in: International Conference on Artificial Intelligence and Data Science, Springer, 2021, pp. 530–539.
[21] S. Urmila, R. A. Kumar, M. K. Singh, Cardiac surveillance system using by the modified kalman filter, in: International Conference on Artificial Intelligence and Data Science, Springer, 2021, pp. 112–122.
[22] A. S. B. Musa, S. K. Singh, P. Agrawal, Suspicious human activity recognition for video surveillance system, in: International Conference on Control, Instrumentation, Communication & Computational Technologies ICCICCT-2014, IEEEXplore, 2014.
[23] N. Mohod, P. Agrawal, V. Madaan, Yolov4 vs yolov5: Object detection on surveillance videos, in: International Conference on Advanced Network Technologies and Intelligent Computing, Springer Nature Switzerland Cham, 2022, pp. 654–665.

[24] N. Mohod, P. Agrawal, V. Madan, Human detection in surveillance video using deep learning approach, in: 2023 6th International Conference on Information Systems and Computer Networks (ISCON), IEEE, 2023, pp. 1–6.
[25] K. Sushma, V. Satyanarayana, M. K. Singh, A copy and move image forged classification by using hybrid neural networks, in: International Conference on Artificial Intelligence and Data Science, Springer, 2021, pp. 101–111.
[26] S. Chauhan, P. Agrawal, V. Madaan, E-gardener: building a plant caretaker robot using computer vision, in: 2018 4th International Conference on Computing Sciences (ICCS), IEEE, 2018, pp. 137–142.
[27] P. Agrawal, A. Shukla, R. Tiwari, Multi lingual speaker recognition using artificial neural network, Advances in Computational Intelligence (2009) 1–9.
[28] P. Agrawal, H. Kaur, G. Kaur, Multi lingual speaker identification on foreign languages using artificial neural network, International Journal of Computer Applications 57 (2012).
[29] I. Chiuchisan, H.-N. Costin, O. Geman, Adopting the internet of things technologies in health care systems, in: 2014 international conference and exposition on electrical and power engineering (EPE), IEEE, 2014, pp. 532–535.