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Active Plant Wall for Green Indoor Climate based on Cloud and Internet of Things

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ABSTRACT

Developing an autonomous plant monitoring system which will perform by sensing and autonomous operation is being used in wide applications. Indoor climate watching by the sensors and management is prevailing in several places like residential homes, office space and many others. Previous research has shown that a healthy plant wall system may successfully reduce particle matter and pollutants in the indoor environment while also stabilising the carbonic acid flow rate. This paper proposes a distant monitoring monitoring system that is unique to plant barriers. To alter the administration procedure, enhance comprehensiveness, boost the productivity of plant walls, and contributing to an experienced interior climate, the system makes use of Internet of Things and Azure cloud infrastructure platforms.

KEYWORDS: Autonomous Monitoring, Azure Cloud, Internet of Things, Plant Wall System.

I. INTRODUCTION

The efficiency of an interior system has a significant impact on people's lives and health. As per the World Health Organization(WHO), this initiative will evaluate the indoor climatic, atmospheric, and electromechanical conditions of business or residential facilities [1].

Health, happiness, perceptions, excellently, and job productivity are all influenced by the warmth humid, air pollution, and light levels of indoor spaces [2]. But, due to various plant care, the traditional technique is very costly and time demanding for providers. need the proper knowledge about plants and also it works in limited geographical area for this the remotely management system and monitoring is the best solution [3].
Key elements such as heat, moisture, and CO2 gas levels are gathered and constantly monitored by t he customer and user in this sort of plant system [4]. This data is transmitted to the consumer with ap propriate feedback, and the water and light impacts are adjusted remotely to maintain a healthy indoo r climate[5]. This system is primarily reliant on public cloud and the services they provide.Growing a variety of plant life on a vertical raised system that is affixed to an internal or external wall or built as

a standalone device is the goal of this plant wall system. The plants, growing medium, irrigation, and drainage systems make up this system [6]. Angiosperms make a substantial contribute to indoor through transpiration, air filtration, and weight gain, which enhances interior climates and reduces energy use.

II. RELATED WORK

The impetus for this project stems from a practical problem that the plant wall sector is facing. A remote control and reporting system that helps to speed the using such of plants walls is desperately needed to alleviate the long-standing pain experienced by plant wall suppliers today. Many resources have been invested in the field of IoT-based surveillance systems research. A cloud-based ambient motion tracking system is designed and developed in [7], and the major components of this design were theoretically examined. The research in [8]–[16] looked into ZigBee-based wireless communication for indoor environmental quality monitoring. Salamone et al. [16] presented a control scheme for increasing the quality of the air and illumination, In order to operate the air exchange and the lights, CO2 and light parameters were added and the solution. This design does not include any cloud infrastructure because it is a stand-alone system. As a result, data logging, real-time tracking, and control

functionalities are not available. Bhattacharya et al. [15] used a sink devices linked to a local machine through a USB port to collect spread ZigBee sensor information and putting it in a local sensing library. To visualise specific sensor data, a GUI programme running on the local machine was created. A system for integrating the management of a heat, ventilating, and air conditioning (HVAC) system focuses on ecological data also was presented but never executed. Using ZigBee sensor networks, Marques and Pitarma [12] and Pitarma et al. [13] created an indoor air pollution monitoring system. Environmental information is automatically delivered to a ZigBee gateway, which is then routed to a personal server through Restful web services, which hosts a MySQL database. To allow access to displayed sensor data and notifications, a web and Android app were created. Yang et al. [11] used a similar approach by increasing the sophistication of the private cloud service. The authors designed an OpenStack cloud services application called iEDMS, built a distributed computing area based on Hadoop, and processed environment data in HBase, that all increased the cloud customer's stability.

[11] and [13] propose methods that make use of commercial visualisation services. In [16], researchers devised a remote tracking method for wineries and creameries. [2] deploys a number of environmental sensors, including temperature, relative humidity, volatile organic compound (VOC), carbon dioxide (CO2), and particle sensors. A microcomputer reads the sensor data on a regular basis and sends it to a remote server computer. Because the system is based on the IEEE 802.15.4 standards, an Ethernet gateway is required to connect IEEE 802.15.4 to the Internet protocol (IP). The sensor information is represented graphically on a website accessible from every web-browser equipped device using a commercial visualisation platform called PI. [13] presents another concept; the authors offer an interior monitoring solution based on the Yeelink platform. They used a Linklt One boards as just a local computing platform to gather heat, humid, light levels, and dusty volume concentration information and communicate it over Wi-Fi to the Yeelink cloud server. The Yeelink cloud service allows end users and managers to verify the indoor status. The use of network access in health is also mentioned. Yang et al. [11] presented a remote pain surveillance system based on the Internet of Things and the cloud. A sensor node is implanted in a facial mask in their application to measure patient pain levels. The facial biosignal is collected, digitally scanned, and analyzed on a community level. By using User Datagram Protocol (UDP) or Transmission C, a Wi-Fi system can be integrated to communicate sensor information to a different server via a gateways. Packet is transferred to a communications network in the cloud, which is coupled to a cloud server for signal processing . data mining. Caretakers may access exposure duration and do real-time analyses using a mobile web application developed on an open source platform. Bluetooth was chosen by Lingsong et al. [17] as the method for acquiring medical device data through Using a cell device, the data was transferred to the Ali public cloud platform using Wi-Fi. As a http server, a rich Internet application (RIA) was created to query and visualise stored data on the cloud storage [18-25].

I. PROPOSED SYSTEM

In the real time management and monitoring system it handles the work remotely from any geographical area and it also improves indoor air quality, lighting quality, user experience and control the air exchange system and lighting system. This technique is applicable to medicinal type plants that are growing out of sunlight. In this plant monitoring system, the automatic watering also included. This automatic watering should be under proper lighting and proper cooling this can be collected by using sensors and post those values over cloud depending upon the scenario and the pump, light, fan will be acted [26-34].

This proposed system contains various advantages and solution for existing work.

1. Cloud platform is used for remotely accessing the data.
2. Cloud handles the daily growth and real passing parameters.
3.Reducing the cost, better performance, reliable, real time remote monitoring, timely feedback and remote control.

IV. METHODOLODY

The system is divided into two sections: a local monitor and control component and a cloud server component.

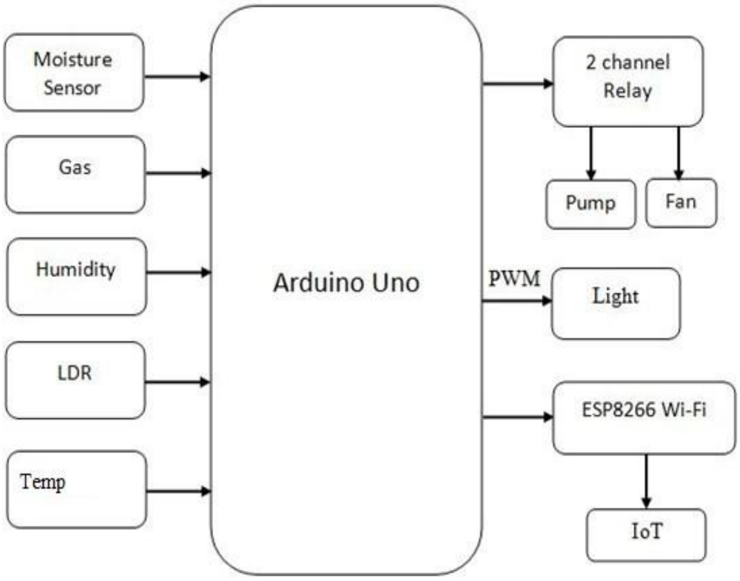

Fig1:Block diagram of Active plant wall for indoor climate based on cloud and IoT

A microprocessor, controller, sensor, and actuator make up the local component [35]. As shown in Fig. 1, environmental sensors such as temperature, humidity, PM, CO2, light, and multichannel gas sensors are linked to and sampled by the microcontroller. By query, the sensor values are supplied to the CPU on a regular basis. For sensor reading, a microcontroller is chosen because of its predictable time, which would be suitable with sensors, although for complex operations, a microprocessor having non-deterministic timing and an os is used. The system's robustness is further improved by separating the duties of the microcontroller and microprocessor [36-39].

The water pump, lighting, and fans installed inside the plant wall are all controlled by the microprocessor autonomously as per timetables. The settings are saved locally as device properties, with an identical duplicate kept in IoT Hub's item duplicate. Administrators may manage the schedule and control the watering, illumination, and ventilation technologies in the plants wall by upgrading the device firmware. The microprocessor chip includes a WiFi module that allows connectivity with the cloud environment through any accessible open network [40]. As illustrated in Fig. 2, the WiFi protocol has evolved into a low-cost, mature, and secure solution for indoor communication as a result of its long development and increased acceptance [41-43].

IoT Hub will evaluate the periodical messages received by the local microprocessor and then route them to various services, like storage and online visualisation. Administrators can see actual data visualisation in the cloud, as well as search and apply mathematical historical information from the server, as illustrated in Fig. 3. Using the website's interface, admins and users may undertake administrative tasks like as upgrading device twins to change time schedules or calling functions to accomplish tasks quickly based on their requirements [44-47].

V. DESIGN AND IMPLEMENTATION

Design and implementation of the solution are presented with details to the connectivity of hardware.

Hardware

1. Microcontroller- Our approach uses an Arduino Uno microcontroller that is powered by an AC-to-DC converter with a 6-20 volt power source. The ATmega328 chip is used in the Arduino Uno. The Arduino Uno includes 14 digital input ports and 6 analogue input pins.

2. Sensors

- Temperature and humidity sensor- Temperature sensor timely sense the temperature of indoor environment. Humidity sensor measures the humidity level.
- CO2 sensor- CO2 sensor detects the co2 concentration in the air.
- PM sensor- In our solution, this sensor is used to measure the PM level. This sensor is capable of detecting
  particles with a diameter of 1 m.
- Gas sensor- The multichannel gas sensor measures the gas concentration.
- Ultrasonic sensor- At the bottom of the plant wall, an ultrasonic sensor detects the water level. It's quite useful because it monitors water levels in real time.
- Actuators- Water pumps, cooling fans, and lighting are among the system's actuator. A 230v AC power supply is used to run the water pump. The power supply for the lights and fans is 24 volts.

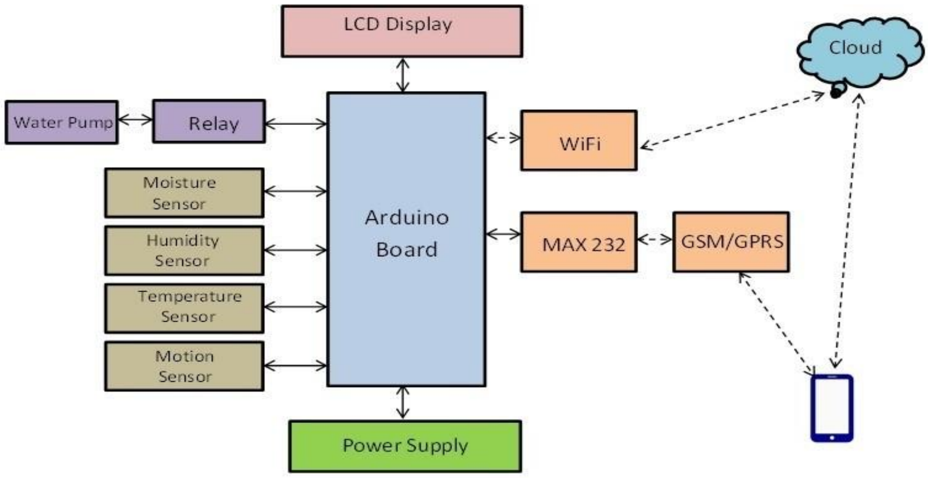

Fig2: Communication diagram of Active plant wall for indoor climate based on cloud and IoT

Software Design

1. Microcontroller- The actual programme, which is responsible for acquiring the measurements and transmitting data, is executed on the Arduino Microcontroller. When the application starts, the appropriate ports for interaction with the sensor are initialised, as well as the hardware interrupts.

2. Cloud part- In the cloud, the remote control and maintenance system for data acquisition, storing, and administrative interface plays a significant role. Cloud services were used to create the solution.

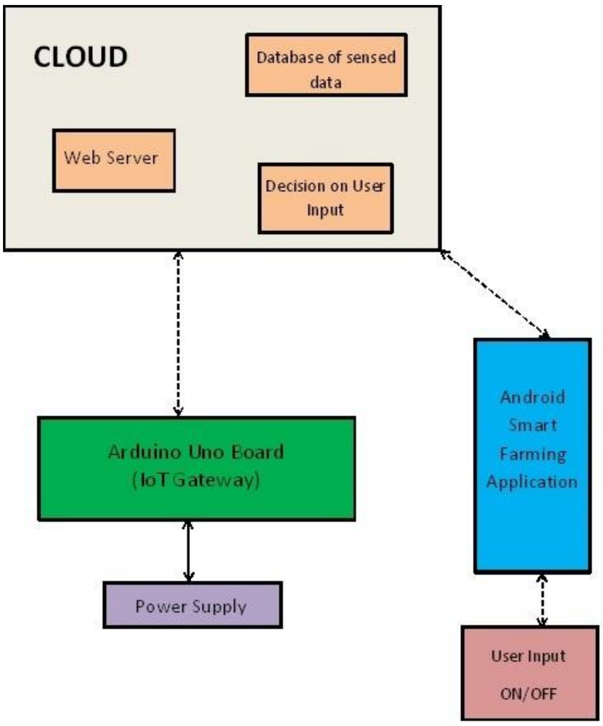

Fig3: Storage diagram of Active plant wall for indoor climate based on cloud and IoT

VI. CONCLUSION AND FUTURE WORK

An experimental installation was used to test and verify the system. The findings show that a cloud and IoT-based remote control and maintenance system for plant walls may provide considerable benefits in terms of dependable performances, real-time surveillance, rapid feedback, and easy remote control. This technology has the potential to considerably benefit plant walls suppliers by enhancing maintenance efficiency while lowering costs. The IoT and Cloud-based solutions help to achieve the study's goal of giving the plant wall system a digital soul. Incorporating security issues when routing data is a research question in terms of expanding the provided technique.

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REFERENCES

[1] M. Luo, W. Ji, B. Cao, Q. Ouyang, and Y. Zhu, ‘‘Indoor climate and thermal physiological adaptation: Evidences from migrants with different cold indoor exposures,’’ Building Environ., vol. 98, pp. 30–38, Mar. 2016.

[2] Boregowda, S.B., Babu Prasad, N.V., Puttamadappa, C. and Mruthyunjaya, H.S., 2015. Energy Balanced Fixed Clustering protocol for Wireless Sensor Networks. International Journal of Computer Science and Network Security, 11(8), pp.166-172.

[3] Sreevathsa, C.V., Daina, K.K., Hemalatha, K.L. and Manjula, K., 2016, July. Increasing the performance of the firewall by providing customized policies. In 2016 2nd International Conference on Applied and Theoretical Computing and Communication Technology (iCATccT) (pp. 561-564). IEEE.

[4] Arun, M., Baraneetharan, E., Kanchana, A. and Prabu, S., 2020. Detection and monitoring of the asymptotic COVID-19 patients using IoT devices and sensors. International Journal of Pervasive Computing and Communications.

[5] Chakraborty, C., Roy, S., Sharma, S., Tran, T., Adhimoorthy, P., Rajagopalan, K. and Jebaranjitham, N., 2021. Impact of Biomedical Waste Management System on Infection Control in

the Midst of COVID-19 Pandemic. The Impact of the COVID-19 Pandemic on Green Societiesenvironmental Sustainability, pp.235-262.

[6] Rachana, C.R., Banu, R., Ahammed, G.A. and Parameshachari, B.D., 2017, August. Cloud Computing–A Unified Approach for Surveillance Issues. In IOP Conference Series: Materials Science and Engineering (Vol. 225, No. 1, p. 012073). IOP Publishing.

[7] L. Zhou, D. Wu, J. Chen, and Z. Dong, ‘‘When computation hugs intelligence: Content-aware data processing for industrial IoT,’’ IEEE Internet Things J., vol. 5, no. 3, pp. 1657–1666, Jun. 2018.

[8] S. B. Baker, W. Xiang, and I. Atkinson, ‘‘Internet of Things for smart healthcare: Technologies, challenges, and opportunities,’’ IEEE Access, vol. 5, pp. 26521–26544, 2017.

[9] G. Neagu, S. Preda, A. Stanciu, and V. Florian, ‘‘A cloud-IoT based sensing service for health monitoring,’’ in Proc. e-Health Bioeng. Conf. (EHB), Jun. 2017, pp. 53–56. Jun 2017.

[10] S. Salvi et al., ‘‘Cloud based data analysis and monitoring of smart multilevel irrigation system using IoT,’’ in Proc. Int. Conf. I-SMAC (IoT Social, Mobile, Anal. Cloud) (I-SMAC), pp. 752–757, Feb. 2017.

[11] Y.-T. Wang, Y.-P. Chiang, C.-H. Wu, C.-T. Yang, S.-T. Chen, and P.-L. Sun, ‘‘The implementation of sensor data access cloud service on HBase for intelligent indoor environmental monitoring,’’ in Proc. 15th Int. Symp. Parallel Distrib. Comput. (ISPDC), pp. 234–239, Jul. 2016.

[12] G. Marques and R. Pitarma, ‘‘An indoor monitoring system for ambient assisted living based on Internet of Things architecture,’’ Int. J. Environ. Res. Public Health, vol. 13, no. 11, p. 1152, 2016.

[13] R. Pitarma, G. Marques, and B. R. Ferreira, ‘‘Monitoring indoor air quality for enhanced occupational health,’’ J. Med. Syst., vol. 41, no. 2, p. 23, Feb. 2016.

[14] F. Salamone, L. Belussi, L. Danza, T. Galanos, M. Ghellere, and I. Meroni, ‘‘Design and development of a nearable wireless system to control indoor air quality and indoor lighting quality,’’ Sensors, vol. 17, no. 5, pp. 10-21, 2017.

[15] S. Bhattacharya, S. Sridevi, and R. Pitchiah, ‘‘Indoor air quality monitoring using wireless sensor network,’’ in Proc. 6th Int. Conf. Sens. Technol. (ICST), pp. 422–427, Dec. 2012

[16] N. Madrid, R. Boulton, and A. Knoesen, ‘‘Remote monitoring of winery and creamery environments with a wireless sensor system,’’ Building Environ., vol. 119, pp. 128–139, Jul. 2017.

[17] Lingsong, T. Hang, and L. Cong, ‘‘A cloud computing based mobile healthcare service system,’’ in Proc. IEEE 3rd Int. Conf. Smart Instrum., Meas. Appl. (ICSIMA), pp. 1–6, Nov. 2015.

[18] Chakraborty, C., Roy, S., Sharma, S., Tran, T., Dwivedi, P. and Singha, M., 2021. IoT Based Wearable Healthcare System: Post COVID-19. The Impact of the COVID-19 Pandemic on Green Societiesenvironmental Sustainability, pp.305-321.

[19]Seyhan, K., Nguyen, T.N., Akleylek, S., Cengiz, K. and Islam, S.H., 2021. Bi-GISIS KE: Modified key exchange protocol with reusable keys for IoT security. Journal of Information Security and Applications, 58, p.102788.

[20] N. Shi, L. Tan, W. Li, X. Qi, K. Yu, “A Blockchain-Empowered AAA Scheme in the Large-Scale HetNet”, Digital Communications and Networks, https://doi.org/10.1016/j.dcan.2020.10.002.

[21] Y. Sun, J. Liu, K. Yu, M. Alazab, K. Lin, “PMRSS: Privacy-preserving Medical Record Searching Scheme for Intelligent Diagnosis in IoT Healthcare”, IEEE Transactions on Industrial Informatics, doi: 10.1109/TII.2021.3070544.

[22] Z. Guo, L. Tang, T. Guo, K. Yu, M. Alazab, A. Shalaginov, “Deep Graph Neural Network-based Spammer Detection Under the Perspective of Heterogeneous Cyberspace”, Future Generation Computer Systems, https://doi.org/10.1016/j.future.2020.11.028.

[23] Nguyen, Ngoc-Tu, and Bing-Hong Liu. "The mobile sensor deployment problem and the target coverage problem in mobile wireless sensor networks are NP-hard." IEEE Systems Journal 13, no. 2 (2018): 1312-1315.

[24] Subramani, Prabu, Ganesh Babu Rajendran, Jewel Sengupta, Rocío Pérez de Prado, and Parameshachari Bidare Divakarachari. "A block bi-diagonalization-based pre-coding for indoor multiple-input-multiple-output-visible light communication system." Energies 13, no. 13 (2020): 3466.

[25] Shahriar, Md Rakib, SM Nahian Al Sunny, Xiaoqing Liu, Ming C. Leu, Liwen Hu, and Ngoc-Tu Nguyen. "MTComm based virtualization and integration of physical machine operations with digital-twins in cyber-physical manufacturing cloud." In 2018 5th IEEE International Conference on Cyber Security and Cloud Computing (CSCloud)/2018 4th IEEE International Conference on Edge Computing and Scalable Cloud (EdgeCom), pp. 46-51. IEEE, 2018.

[26] Parameshachari, B. D., Rashmi P. Kiran, P. Rashmi, M. C. Supriya, Rajashekarappa, and H. T. Panduranga. "Controlled partial image encryption based on LSIC and chaotic map." In ICCSP, pp. 60-63. 2019.

[27] Nguyen, Ngoc-Tu, Bing-Hong Liu, Van-Trung Pham, and Ting-Yan Liou. "An efficient minimum-latency collision-free scheduling algorithm for data aggregation in wireless sensor networks." IEEE Systems Journal 12, no. 3 (2017): 2214-2225.

[28] Manjanaik, N., B. D. Parameshachari, S. N. Hanumanthappa, and Reshma Banu. "Intra Frame Coding In Advanced Video Coding Standard (H. 264) to Obtain Consistent PSNR and Reduce Bit Rate for Diagonal Down Left Mode Using Gaussian Pulse." In IOP Conference Series: Materials Science and Engineering, vol. 225, no. 1, p. 012209. IOP Publishing, 2017.

[29] Nguyen, Ngoc-Tu, Bing-Hong Liu, Shao-I. Chu, and Hao-Zhe Weng. "Challenges, designs, and performances of a distributed algorithm for minimum-latency of data-aggregation in multi-channel WSNs." IEEE Transactions on Network and Service Management 16, no. 1 (2018): 192-205.

[30] Parameshachari, B. D., H. T. Panduranga, and Silvia liberata Ullo. "Analysis and computation of encryption technique to enhance security of medical images." In IOP Conference Series: Materials Science and Engineering, vol. 925, no. 1, p. 012028. IOP Publishing, 2020.

[31] Do, Dinh-Thuan, Tu Anh Le, Tu N. Nguyen, Xingwang Li, and Khaled M. Rabie. "Joint impacts of imperfect CSI and imperfect SIC in cognitive radio-assisted NOMA-V2X communications." IEEE Access 8 (2020): 128629-128645.

[32] Rajendran, Ganesh B., Uma M. Kumarasamy, Chiara Zarro, Parameshachari B. Divakarachari, and Silvia L. Ullo. "Land-use and land-cover classification using a human group-based particle swarm optimization algorithm with an LSTM Classifier on hybrid pre-processing remote-sensing images." Remote Sensing 12, no. 24 (2020): 4135.

[33] L. Tan, N. Shi, K. Yu, M. Aloqaily, Y. Jararweh, “A Blockchain-Empowered Access Control Framework for Smart Devices in Green Internet of Things”, ACM Transactions on Internet Technology, vol. 21, no. 3, pp. 1-20, 2021,https://doi.org/10.1145/3433542.

[34] Z. Guo, A. K. Bashir, K. Yu, J. C. Lin, Y. Shen, “Graph Embedding-based Intelligent Industrial Decision for Complex Sewage Treatment Processes”, International Journal of Intelligent Systems， 2021, doi: 10.1002/int.22540.

[35] Hu, Liwen, Ngoc-Tu Nguyen, Wenjin Tao, Ming C. Leu, Xiaoqing Frank Liu, Md Rakib Shahriar, and SM Nahian Al Sunny. "Modeling of cloud-based digital twins for smart manufacturing with MT connect." Procedia manufacturing 26 (2018): 1193-1203.

[36] Puttamadappa, C., and B. D. Parameshachari. "Demand side management of small scale loads in a smart grid using glow-worm swarm optimization technique." Microprocessors and Microsystems 71 (2019): 102886.

[37] Bhuvaneswary, N., S. Prabu, S. Karthikeyan, R. Kathirvel, and T. Saraswathi. "Low Power Reversible Parallel and Serial Binary Adder/Subtractor." Further Advances in Internet of Things in Biomedical and Cyber Physical Systems (2021): 151.

[38] Hemalatha, K. L., SUNILKUMAR MANVI, and HN SURESH. "ADAPTIVE WEIGHTED-COVARIANCE REGULARIZED KERNEL FUZZY C MEANS ALGORITHM FOR MEDICAL IMAGE SEGMENTATION." Journal of Theoretical & Applied Information Technology 95, no. 14 (2017).

[39] Z. Guo, K. Yu, A. Jolfaei, A. K. Bashir, A. O. Almagrabi, and N. Kumar, “A Fuzzy Detection System for Rumors through Explainable Adaptive Learning”, IEEE Transactions on Fuzzy Systems, doi: 10.1109/TFUZZ.2021.3052109.

[40] Fathima, N., Ahammed, A., Banu, R., Parameshachari, B.D. and Naik, N.M., 2017, December. Optimized neighbor discovery in Internet of Things (IoT). In 2017 International Conference on Electrical, Electronics, Communication, Computer, and Optimization Techniques (ICEECCOT) (pp. 1-5). IEEE.

[41]Naeem, M.A., Nguyen, T.N., Ali, R., Cengiz, K., Meng, Y. and Khurshaid, T., 2021. Hybrid Cache Management in IoT-based Named Data Networking. IEEE Internet of Things Journal.

[42] Hemalatha, K. L., S. M. Ashitha, and S. R. Meghana. "Design and implementation of modified FCM in the detection of brain tumor." Int. J. Adv. Sci. Res. Eng 3, no. 4 (2017): 2850-2858.

[43] Subramani, Prabu, Fadi Al-Turjman, Rajagopal Kumar, Anusha Kannan, and Anand Loganthan. "Improving medical communication process using recurrent networks and wearable antenna s11 variation with harmonic suppressions." Personal and Ubiquitous Computing (2021): 1-13.

[44] Bhuvaneswary, N., S. Prabu, K. Tamilselvan, and K. G. Parthiban. "Efficient Implementation of Multiply Accumulate Operation Unit Using an Interlaced Partition Multiplier." Journal of Computational and Theoretical Nanoscience 18, no. 4 (2021): 1321-1326.

[45] S. Chen, L. Zhang, Y. Tang, C. Shen, R. Kumar, K. Yu, U. Tariq, and A. K. Bashir, "Indoor Temperature Monitoring Using Wireless Sensor Networks: A SMAC Application in Smart Cities", Sustainable Cities and Society, vol. 61, p. 102333, July 2020.

[46] W. Zeng, Z. Guo, Y. Shen, A. K. Bashir, K. Yu, Y. D. Al-Otaibi, and X. Gao, "Data-Driven Management for Fuzzy Sewage Treatment Processes Using Hybrid Neural Computing", Neural Computing and Applications, https://doi.org/10.1007/s00521-020-05655-3.

[47] F. Ding, G. Zhu, M. Alazab, X. Li, and K. Yu, "Deep-Learning-Empowered Digital Forensics for Edge Consumer Electronics in 5G HetNets", IEEE Consumer Electronics Magazine, doi: 10.1109/MCE.2020.3047606.