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ROBOTIC GREENHOUSE EFFECT HANDLING

Mr. S. Ranjith Kumar[a], Mamidala Anusha [b], Kusa Nirosha [c], Arisem Meghana [d], Banothu Chaithanya [e]

[a] Assistant Professor, Department of Electronics & Communication Engineering, Balaji Institute of Technology and Science Narsampet Warangal.
[a, b, c, d,e] Student, Department of Electronics & Communication Engineering, Balaji Institute of Technology & Science, Warangal.

ABSTRACT

Using automation and robotics, the "Greenhouse Managing Robot" project offers a novel approach to effective greenhouse management. This project aims to create an intelligent and autonomous robot capable of monitoring environmental conditions, specifically temperature and humidity, within a greenhouse and providing timely plant care through automated watering based on a predetermined path. This is in response to the growing demand for sustainable agriculture and the need to optimize resource utilization. The following are this project's main goals. Environmental Observation With its sensors, the Greenhouse Managing Robot keeps a constant eye on the greenhouse's temperature and humidity conditions. These sensors gather data in real time to guarantee that plants are grown in the best possible conditions[1][2]. Autonomous Navigation and Data Visualization. The robot is made to follow preset routes to navigate the greenhouse on its own. It makes use of sophisticated algorithms and obstacle avoidance techniques to guarantee secure and effective mobility. This independence reduces the requirement for human involvement.

Keywords: temperature sensor, humidity sensor, monitoring, controlling, relay.

1. Introduction:

The "Greenhouse Managing Robot" project is a ground-breaking effort that addresses the changing difficulties in contemporary farming methods at the nexus of robotics and agriculture. Agricultural systems are under increasing pressure to provide larger yields while limiting resource usage and environmental effect due to the growing global population. This research introduces an intelligent robotic greenhouse management solution in an attempt to address these issues proactively[3]. The Greenhouse Managing Robot is essentially an intricate combination of cutting-edge technologies, including powerful sensors, self-navigating algorithms, and precise control mechanisms. The creation of an intelligent feedback loop between the robot and the greenhouse environment is the initiative's main goal. The robot, which has high-precision sensors, continuously measures and records data on temperature and humidity, two essential elements that affect plant growth. Greenhouse operators are therefore equipped with practical insights into the current conditions thanks to the processing and display of this data through a simple interface[4][5]. The robot's ability to operate independently is demonstrated when it moves through the greenhouse in a smooth manner, following preset routes and using obstacle avoidance techniques to keep itself safe and productive. This project's incorporation of an automated irrigation system is a key component. The robot uses real-time environmental data to guide its precise and timely watering routines, which maximize water efficiency and create ideal conditions for plant health.

2. Objective:

The primary goal of the "Greenhouse Managing Robot" project is to create an intelligent, self-governing robotic system that will revolutionize greenhouse management. The primary goal of the project is to automate crucial parts of greenhouse operations[6]. To this end, sophisticated sensors will be installed to monitor temperature and humidity in real-time. The goal of this project is to provide fast and accurate data to greenhouse operators so they may make well-informed decisions for the best possible plant growth. The project further aspires to achieve autonomous navigation within the greenhouse, employing sophisticated algorithms to traverse predetermined paths while adeptly avoiding obstacles, thereby reducing the necessity for manual intervention. A pivotal goal is the creation of a user-friendly display interface that visually represents the collected environmental data. This interface aims to empower greenhouse operators with a comprehensive and intuitive platform, enhancing their ability to interpret and act upon real-time information effectively[7][8].

3 Existing System:

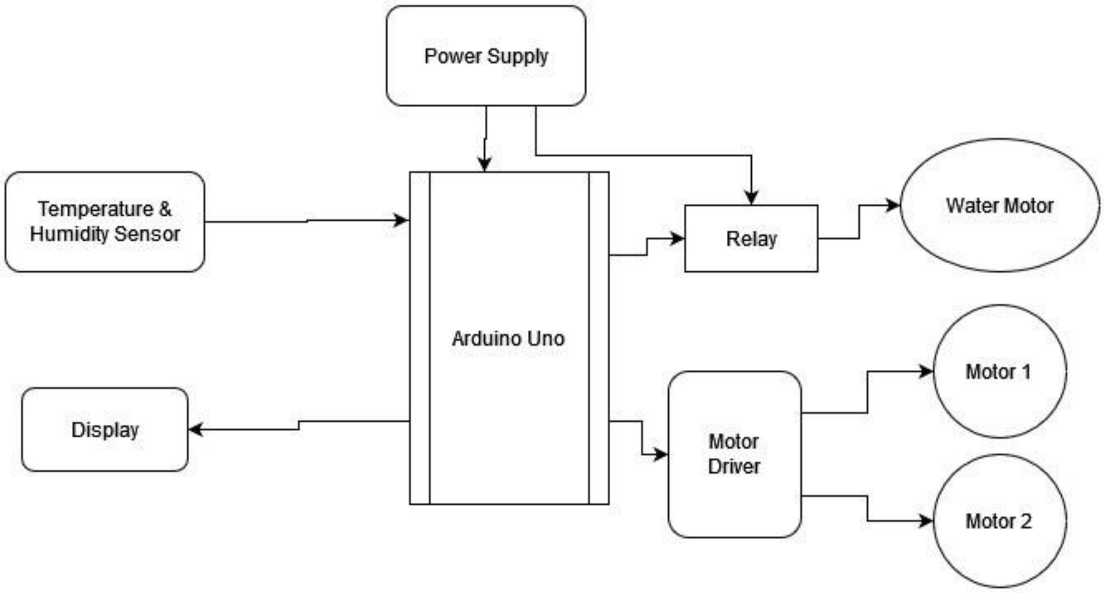
Current greenhouse management systems generally include a number of components intended to enhance the growing environment and promote productive crop output. Climate control systems are often integrated with environmental monitoring components, such as humidity and temperature sensors, to regulate greenhouse conditions. Irrigation systems use preset schedules to guarantee appropriate water distribution, which is where automation comes in. Tools for data logging and analysis make it possible to gather and store information, giving rise to insights into environmental trends that support continuous improvement[9]. User interfaces offer real-time data visualization, allowing operators to monitor and adjust conditions as needed. Security measures, such as surveillance systems and access control, contribute to safeguarding the greenhouse. Some systems also integrate external factors, like weather forecasts, to enhance decision-making. While these existing systems are highly effective in managing environmental parameters and automating routine tasks, the "Greenhouse Managing Robot" project introduces a distinct advantage by incorporating a physical robot capable of autonomous navigation and targeted plant watering. This innovation adds a new dimension to the efficiency and precision of greenhouse management, marking a departure from purely stationary systems.

4. Proposing System:

Through the integration of cutting-edge robotics and automation technology, the suggested "Greenhouse Managing Robot" system presents a novel approach to greenhouse management. The system's key component is an autonomous robot outfitted with cutting-edge sensors for in-the-moment monitoring of vital environmental variables like humidity and temperature. The robot uses sophisticated algorithms for autonomous navigation, moving along pre-planned routes inside the greenhouse and avoiding obstacles to maintain efficiency and safety[10][11]. The use of an automated plant-watering system that adapts dynamically to the real-time environmental data the robot gathers is a significant breakthrough. Plant health is promoted and resource efficiency is maximized using this system's ability to precisely and promptly water plants depending on their real needs. By including this automatic watering mechanism, the suggested solution stands out from traditional greenhouse management techniques and improves greenhouse operations' efficiency. Greenhouse operators can view a full display of environmental data in real time thanks to the user-friendly and intuitive design of the user interface. By enabling operators to make knowledgeable choices and modifications, this interface promotes cooperative communication between the robotic system and human supervision. The suggested method places a strong emphasis on eco-friendly and sustainable practices. The method is in line with sustainable agriculture principles since it minimizes human intervention and reduces resource waste through accurate watering. The use of the robotic component not only improves operational effectiveness but also facilitates scalability, enabling the system to adjust to different greenhouse shapes and sizes. In conclusion, the "Greenhouse Managing Robot" combines advanced environmental monitoring, autonomous robotics, and sustainable practices to offer a comprehensive and novel approach to greenhouse management. By combining these components, the goal is to improve upon the shortcomings of current systems and establish new benchmarks for accuracy, productivity, and scalability in contemporary greenhouse farming. An overview of previous studies in the field of Internet of Things applications in agriculture is given in the literature review[12]. The writers go over the different parts and technology that go into smart agriculture systems and emphasize how IoT can improve agricultural practices. IoT-based agricultural ecosystems, IoT application classification, privacy and security issues, and IoT applications for greenhouse monitoring with Zigbee, cloud-based systems, Arduino Mega, and Raspberry Pi are some of the earlier studies in this field.

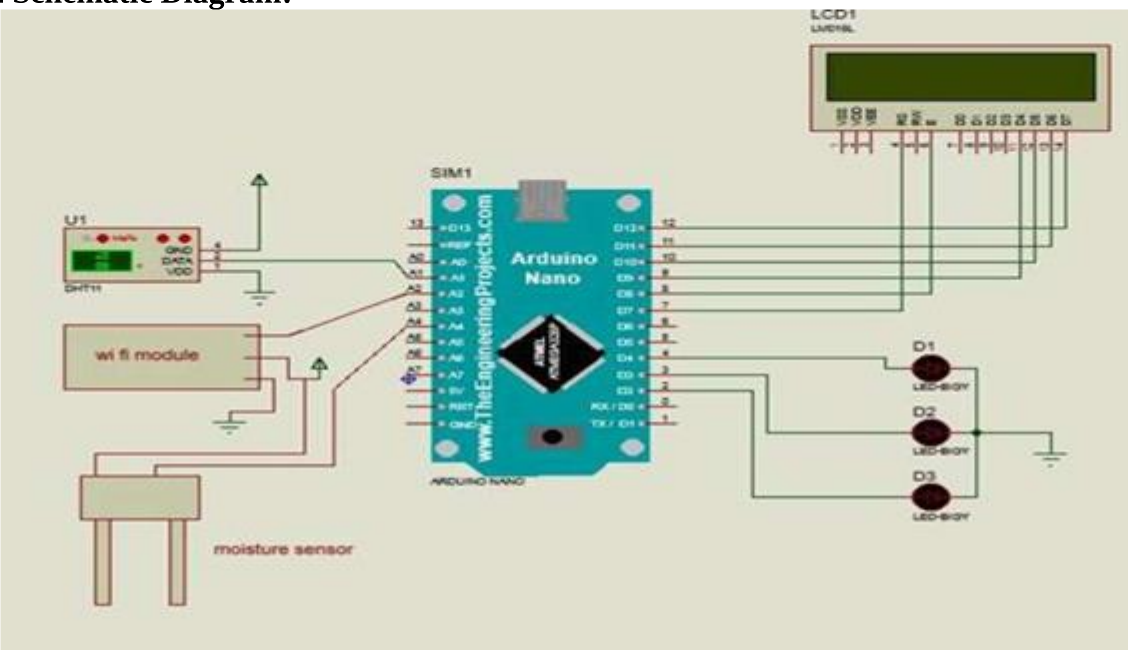
5. Block Diagram and Operation:

5.1: Block Diagram:



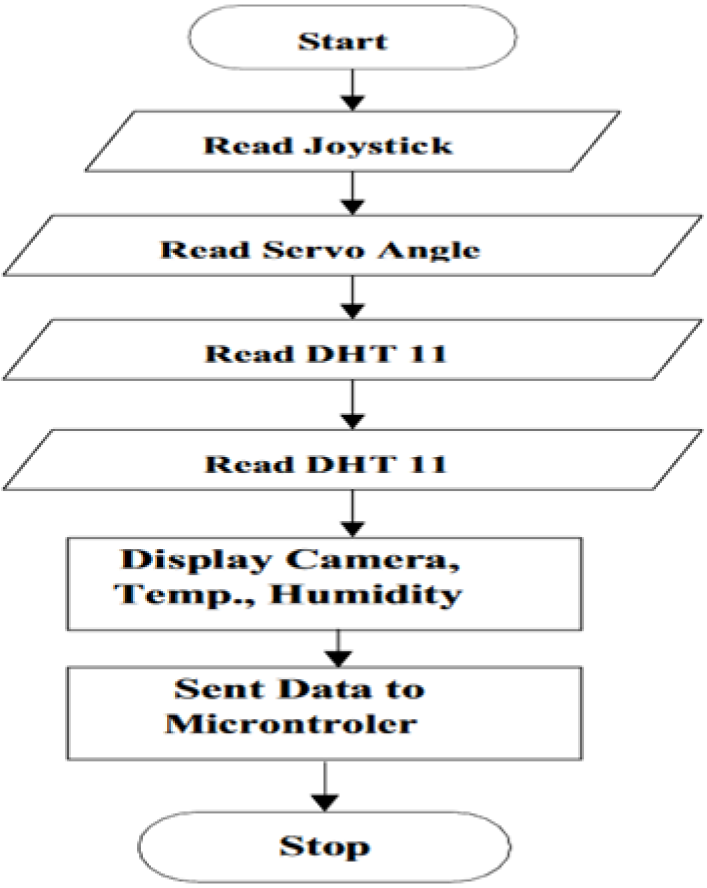
This will take measurements and transmit the information to an Arduino Uno, which will compute the precise temperature and humidity levels inside the green greenhouse. The DHT11 and DHT22 are two widely used temperature and humidity sensors on the market. It uses the humidity sensing component, depicted in Fig., which consists of two electrodes with a moisture-holding substrate sandwiched between them, to measure humidity. The resistance between these electrodes or the substrate's electrical conductivity both alter with variations in humidity[13]. The IC measures and processes this change in resistance, preparing it for a microcontroller to read. This module handles the necessary Bluetooth connections and message transceiving between the Arduino controller and mobile app. permits Bluetooth-enabled devices, like as smartphones, to communicate with the Arduino. Wireless updates and commands can be sent by users[14]. The motors require high power to operate other than the operational voltage of theArduino. Also, the Arduino itself is not powerful enough to provide such power. In order to run and regulate motors in response to the control signals generated by the Arduino Uno controller, we employ motor drivers. A greenhouse managing robot's motor drivers are the parts in charge of moving the motors that power different operations like ventilation, watering, and navigation. These drivers transfer commands from the robot's control system into signals that govern the motors' direction and speed. They guarantee accurate and effective mobility, enabling the robot to carry out activities in the greenhouse setting with effectiveness. In order to do necessary tasks, they operate cars. To operate our robot, we have two motors. For left and right vehicle movement, respectively, we employ two motors. The capacity of the motors in a greenhouse managing robot usually varies according to the particular tasks that the robot is intended to carry out. For instance, sensors may need to be moved around the greenhouse or vents may need to be opened and closed by tiny motors. Tasks include controlling the robot's movement over various terrains or managing heavy machinery like conveyor belts or irrigation systems may require larger, more powerful motors. The torque, speed, and power requirements of the jobs the motors must perform effectively in the greenhouse environment are taken into consideration while selecting their capacity. This will be used to turn the water motor on and off so that the plants in the designated area get watered. Relays are electromagnetic switches that can turn on or off much greater electric currents. They are powered by relatively tiny electric currents. An electromagnet, which is a coil of wire that temporarily turns into a magnet when electricity passes through it, is the central component of a relay[15][16]. The core cannot produce a magnetic field and cannot function as a magnet when no voltage is provided to it. As a result, the moveable armature cannot be drawn to it. The core begins to function as a magnet when enough voltage is added to it, causing a magnetic field to surround it. Because the movable armature is within its range, the magnetic field produced by the core attracts it, changing the armature's location. This motor feeds water to plants by pushing it onto a water tank in the robot. Typically, a greenhouse managing robot's water motor is in charge of pumping and distributing water throughout the greenhouse. The size of the greenhouse and the plants' watering requirements may affect its capacity. When water is needed, the robot's system controls the water motor, which is connected to a water source and moves water to designated locations or plants. It guarantees accurate and effective watering, which promotes the general well-being and development of the greenhouse's plants. The water motor may additionally have sensors or monitoring systems installed in order to monitor water levels and adjust watering schedules for optimal efficiency.

5.2 Schematic Diagram:



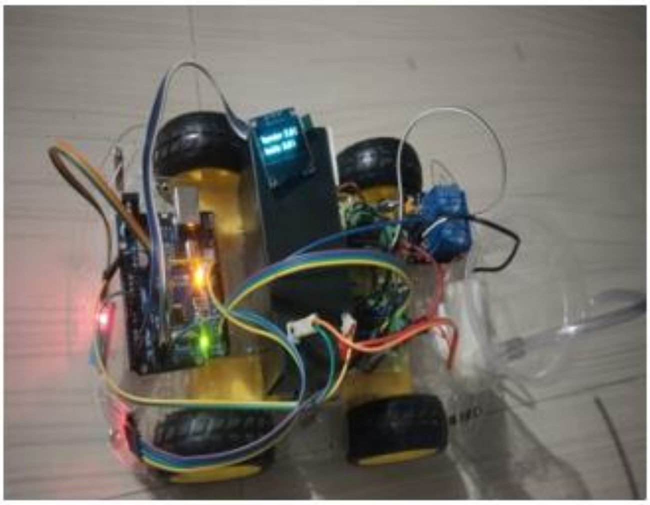
Hardware designed for greenhouse monitoring and control is used to regulate the greenhouse's environmental conditions and bring it into good shape. The greenhouse's temperature and humidity are the parameters. The humidity sensor, Arduino UNO microcontroller, wireless and serial communication, LED module replacement for water sprayer, stepper motor, greenhouse model, personal computer acting as a server, and power supply unit are all part of the monitoring and controlling system for the greenhouse. The sensor's output is converted to an input by the microcontroller and transmitted via serial communication to a computer. The computer's job is to provide the data to an Android smartphone's application software via wireless communication[17]. The Android smartphone's job is to manage The greenhouse monitoring and control system must be properly designed in order to be implemented. The system's schematic was made in this manner using Proteus software. An extensive blueprint of the intelligent greenhouse is showcased. The main microcontroller, an Arduino Nano, is connected to every sensor and module. The microcontroller functions as the central component of the system, receiving and processing signals from the sensors and displaying the necessary commands to the system.

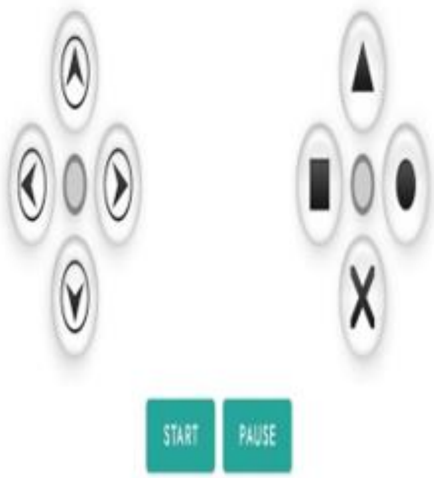
5.3 Flow Chart:



The goal of the project is to use the Raspberry Pi to build a wireless mobile robot control system that will work with a smart greenhouse monitoring system. The mobile robot is intended to function in a greenhouse setting. It has a tricycle drive system and two degrees of freedom (2 DOF) manipulator arms for a monitoring camera[18][19]. Furthermore, real-time environmental conditions monitoring in the greenhouse is made possible by temperature and humidity sensors that are connected to the Raspberry Pi. Through the available intranet network in the greenhouse, the Raspberry Pi can access the graphical user interface (GUI) application wirelessly by using VNC remote desktop technology. The hardware realization involves the construction of the mobile robot with a tricycle drive system, incorporating DC motors, a servo motor, a 2 DOF arm manipulator, and a 5M Pixel resolution camera.The Raspberry Pi 3 controller facilitates wireless communication, and a DHT11 sensor is employed to measure temperature and humidity in real-time[20][21]. The system is designed to be remotely controlled through a graphical user interface. The block diagram and flowchart illustrate the system's architecture and control logic. These days, Bluetooth is widely used. We utilize it in millions of items every day, such as activity trackers, game controllers, laptops, headsets, and cellphones. It's a word we hear all the time. Bluetooth is a great way to wirelessly transfer small amounts of data over short distances (less than 100 meters) in the field of embedded devices. It can be utilized for smartphone-based project management or real-time data logging.

6. Results:





Our system's primary controller was an Arduino Uno R3.To monitor temperature and humidity variations inside the greenhouse, we employed a DHT 11 sensor.The temperature and humidity data from the DHT 11 Sensor were displayed on the OLED display that we attached.To operate the robot, we employed the HC-05 Bluetooth module.To operate the robot, we employed a Bluetooth app for Android devices[22]. Using a water motor and praise from the Bluetooth app, we watered the plants in the greenhouse. We utilized a 5-volt input signal relay to operate the water motor.We employed L293D modules to use a 4-wheel drive with motors to regulate the robot's movements. Using the HC 05 module, Arduino connects to the app over Bluetooth to receive user orders and carry out actions in response to those commands. The robot advances upon receiving 'A'. The robot retreats when it receives 'B'.The robot turns right when it receives the letter "C."Once 'D' is input, the robot moves to the left.The robot pauses when it receives the letter "E."The robot uses a water motor to begin watering the plant when it receives the letter "F."The robot utilizes the Operation orders to stop the water in the plan when 'G' is received. We may control this robot with the Bluetooth app. The primary goal of this project is to automate greenhouse monitoring. In this project, a self-controlled robotic system is introduced to monitor the conditions of the plants and the greenhouse environment. The robot may gather information from the plants and forward it to a centralized server for analysis[23][24]. The robot has specialized sensors to gather information about each plant's temperature, humidity, pH level, and soil wetness. These files are sent to a centralized server that manages the greenhouse's database. Each month, those data are examined. As a result, farmers can obtain very accurate historical data in addition to real-time data. Additionally, by taking pictures of leaves, one can identify the diseases powdery mildew and yellowish mildew. .. Each month, those data are examined. As a result, farmers can obtain very accurate historical data in addition to real-time data. Additionally, by taking pictures of leaves, one can identify the diseases powdery mildew and yellowish mildew. The structure implementation of the robot is made to be extensible. For further development, this robot's features can be increased and new technologies can be included.

7.Advantages and Applications:

7.1 Advantages:

Numerous benefits provided by the "Greenhouse Managing Robot" technology add to its creative approach to greenhouse management.

1. These benefits are intended to improve greenhouse cultivation's efficiency, accuracy, and sustainability by addressing issues with conventional systems**.** Plants develop best in ideal conditions when temperature and humidity are monitored in real time, which lowers the risk of less-than-ideal growth or crop losses[25][26].
2. Advanced algorithms for autonomous navigation reduce the need for manual labor and cover the entire greenhouse without human intervention, improving operational efficiency.

7.2 Applications:

1. large commercial greenhouse projects. increases operational efficiency through personnel cost reduction, growing conditions guaranteed for high-volume crop cultivation, and automation of repetitive operations.
2. Agricultural research centers and institutions. Enables controlled experimentation by providing precise environmental control and data collection, supporting research efforts to optimize crop yields and sustainability.

8. Conclusion

The primary goal of this project is to automate greenhouse monitoring. In this project, a self-controlled robotic system is introduced to monitor the conditions of the plants and the greenhouse environment. The robot may gather information from the plants and forward it to a centralized server for analysis. The robot has specialized sensors to gather information about each plant's temperature, humidity, pH level, and soil wetness.

8. Future work

Greenhouse robots can become more predictive and adaptive by combining machine learning methods with artificial intelligence (AI). They can forecast future results and optimize operations by using historical data. For instance, they are able to predict plant illnesses based on environmental factors and adjust their preventive measures accordingly.

In conclusion, there is a lot of opportunity for growth in automation, precision agriculture, sustainability, remote monitoring, AI integration, modularity, scalability, collaborative farming, and education with an Arduino-powered greenhouse management robot.

9. References:

[1] Benjula Anbu Malar M B, Praveen R, and Kavi Priya K P, Hand Gesture Control Robot, IJITEE 2019.

[2] Deekshith Kumar, Harsha K C, Koushik D Kasolli, Yashwanth Surya Kumar, Prof. Ramesh Mallya P) 2022 IJCRT VOICE AND GESTURE CONTROLLED ROBOT.

[3] Madhu Kumar Vanteru, K.A. Jayabalaji, i-Sensor Based healthcare monitoring system by LoWPAN-based rchitecture,Measurement: Sensors,Volume 28,2023,100826,ISSN 2665-9174,https://doi.org/10.1016/j.measen.2023.100826.

[4] Ramesh, P.S., Vanteru, Madhu.Kumar., Rajinikanth, E. et al. Design and Optimization of Feedback Controllers for Motion Control in the Manufacturing System for Digital Twin. SN COMPUT. SCI. 4, 782 (2023). https://doi.org/10.1007/s42979-023-02228-8

[5] Madhu. Kumar. Vanteru, T. V. Ramana, et al , "Modeling and Simulation of propagation models for selected LTE propagation scenarios," 2022 International Conference on Recent Trends in Microelectronics, Automation, Computing and Communications Systems (ICMACC), Hyderabad, India, 2022, pp. 482-488, doi: 10.1109/ICMACC54824.2022.10093514.

[6] Allanki Sanyasi Rao, Madhu Kumar Vanteru et al. (2023). PAPR and BER Analysis in FBMC/OQAM System with Pulse Shaping Filters and Various PAPR Minimization Methods. International Journal on Recent and Innovation Trends in Computing and Communication, 11(10), 2146–2155. https://doi.org/10.17762/ijritcc.v11i10.8899.

[7] N. Sivapriya, Madhu Kumar Vanteru, et al , "Evaluation of PAPR, PSD, Spectral Efficiency, BER and SNR Performance of Multi-Carrier Modulation Schemes for 5G and Beyond," SSRG International Journal of Electrical and Electronics Engineering, vol. 10, no. 11, pp. 100-114, 2023. Crossref, https://doi.org/10.14445/23488379/IJEEE-V10I11P110

[8] Chandini Banapuram, Azmera Chandu Naik, Madhu Kumar Vanteru, et al, "A Comprehensive Survey of Machine Learning in Healthcare: Predicting Heart and Liver Disease, Tuberculosis Detection in Chest X-Ray Images," SSRG International Journal of Electronics and Communication Engineering, vol. 11, no. 5, pp. 155-169, 2024. Crossref, https://doi.org/10.14445/23488549/IJECE-V11I5P116.

[9] Madhu. Kumar. Vanteru, et al, "Empirical Investigation on Smart Wireless Autonomous Robot for Landmine Detection with Wireless Camera," 2022 5th International Conference on Contemporary Computing and Informatics (IC3I), Uttar Pradesh, India, 2022, pp. 200-205, doi: 10.1109/IC3I56241.2022.10072936.

[10] S. Bhatnagar, Madhu. Kumar. Vanteru et al., "Efficient Logistics Solutions for E-Commerce Using Wireless Sensor Networks," in IEEE Transactions on Consumer Electronics, doi: 10.1109/TCE.2024.3375748.

[11] V, Sravan Kumar, Madhu Kumar Vanteru et al. 2024. “BCSDNCC: A Secure Blockchain SDN Framework for IoT and Cloud Computing”. International Research Journal of

Multidisciplinary Technovation 6 (3):26-44. https://doi.org/10.54392/irjmt2433.

[12] Madhu Kumar, Vanteru. & Ramana, T.. (2022). Fully scheduled decomposition channel estimation based MIMO-POMA structured LTE. International Journal of Communication Systems. 35. 10.1002/dac.4263.

[13] Vanteru. Madhu. Kumar and T. V. Ramana, "Position-based Fully-Scheduled Precoder Channel Strategy for POMA Structured LTE Network," 2019 IEEE International Conference on Electrical, Computer and Communication Technologies (ICECCT), Coimbatore, India, 2019, pp. 1-8, doi: 10.1109/ICECCT.2019.8869133.

[14] Madhu. Kumar. Vanteru, T. V. Ramana, A. C. Naik, C. Adupa, A. Battula and D. Prasad, "Modeling and Simulation of propagation models for selected LTE propagation scenarios," 2022 International Conference on Recent Trends in Microelectronics, Automation, Computing and Communications Systems (ICMACC), Hyderabad, India, 2022, pp. 482-488, doi: 10.1109/ICMACC54824.2022.10093514.

[15] Vanteru.Madhu Kumar,Dr.T.V.Ramana" Virtual Iterative Precoding Based LTE POMA Channel Estimation Technique in Dynamic Fading Environments" International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8 Issue-6, April 2019

[16] Vanteru .Madhu Kumar,Dr.T.V.Ramana, Rajidi Sahithi" User Content Delivery Service for Efficient POMA based LTE Channel Spectrum Scheduling Algorithm" International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-9 Issue-2S3, December 2019.

[17] Vanteru.Madhu Kumar,Dr.T.V.Ramana" Virtual Iterative Precoding Based LTE POMA Channel Estimation Technique in Dynamic Fading Environments" International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8 Issue-6, April 2019

[18] Karthik Kumar Vaigandla and J. Benita, " PAPR REDUCTION OF FBMC-OQAM SIGNALS USING PHASE SEARCH PTS AND MODIFIED DISCRETE FOURIER TRANSFORM SPREADING," ARPN Journal of Engineering and Applied Sciences, VOL. 18, NO. 18, pp.2127-2139, SEPTEMBER 2023

[19] aigandla, Karthik Kumar and Benita, J. 'Selective Mapping Scheme Based on Modified Forest Optimization Algorithm for PAPR Reduction in FBMC System'. Journal of Intelligent & Fuzzy Systems, vol. 45, no. 4, pp. 5367-5381, October 2023, DOI: 10.3233/JIFS-222090.

[20] Vaigandla, K. K. ., & Benita, J. (2023). A Novel PAPR Reduction in Filter Bank Multi-

Carrier (FBMC) with Offset Quadrature Amplitude Modulation (OQAM) Based VLC Systems. International Journal on Recent and Innovation Trends in Computing and Communication, 11(5), 288–299. https://doi.org/10.17762/ijritcc.v11i5.6616

[21] Karthik Kumar Vaigandla, J.Benita, "PRNGN - PAPR Reduction using Noise Validation and Genetic System on 5G Wireless Network," International Journal of Engineering Trends and Technology, vol. 70, no. 8, pp. 224-232, 2022. Crossref, https://doi.org/10.14445/22315381/IJETT-V70I8P223

[22] Karthik Kumar Vaigandla and J.Benita (2022), Novel Algorithm for Nonlinear Distortion Reduction Based on Clipping and Compressive Sensing in OFDM/OQAM System. IJEER 10(3), 620-626. https://doi.org/10.37391/IJEER.100334.

[23] K. K. Vaigandla, "Communication Technologies and Challenges on 6G Networks for the Internet: Internet of Things (IoT) Based Analysis," 2022 2nd International Conference on Innovative Practices in Technology and Management (ICIPTM), 2022, pp. 27-31, doi: 10.1109/ICIPTM54933.2022.9753990.

[24] Vaigandla, K. K., Karne, R., Siluveru, M., & Kesoju, M. (2023). Review on Blockchain Technology : Architecture, Characteristics, Benefits, Algorithms, Challenges and Applications. Mesopotamian Journal of CyberSecurity, 2023, 73–85. https://doi.org/10.58496/MJCS/2023/012

[25] Karthik Kumar Vaigandla, Allanki Sanyasi Rao and Kallepelli Srikanth. Study of Modulation Schemes over a Multipath Fading Channels. International Journal for Modern Trends in Science and Technology 2021, 7 pp. 34-39. https://doi.org/10.46501/IJMTST0710005

[26] Karthik Kumar Vaigandla, Bolla Sandhya Rani, Kallepelli Srikanth, Thippani Mounika, RadhaKrishna Karne, “Millimeter Wave Communications: Propagation Characteristics, Beamforming, Architecture, Standardization, Challenges and Applications”. Design Engineering, Dec. 2021, pp. 10144-10169,

[27] Karthik Kumar Vaigandla, Radhakrishna Karne, Allanki Sanyasi Rao, "Analysis of MIMO-OFDM: Effect of Mutual Coupling, Frequency Response, SNR and Channel Capacity", YMER Digital - ISSN:0044-0477, vol.20, no.10 - 2021, pp.118-126, 2021.

[28] Karthik Kumar Vaigandla, Shivakrishna Telu, Sandeep Manikyala, Bharath Kumar Polasa, Chelpuri Raju, "Smart And Safe Home Using Arduino," International Journal Of Innovative Research In Technology, Volume 8, Issue 7, 2021,pp.132-138

[29] Karthik Kumar Vaigandla, Mounika Siluveru and Sandhya Rani Bolla, “Analysis of PAPR

and Beamforming For 5G MIMO-OFDM", International journal of analytical and experimental modal analysis, Volume XII, Issue X, 2020, pp.483-490.