IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 11, November 2024

DOI: 10.17148/IJARCCE.2024.131130

6G VISION: NEXT-GEN IOT AND EDGE AUTOMATION MODEL DEVELOPED BY USING DAS

Prof. Hema C[1], Amit Kumar[2], Chinmayi B S[3], Hemanth Gowda S V[4], Vinutha C[5]

Assistant professor, Electronics and communication Department, East West Institute of Technology, Bangalore, India[1]

Student, Electronics and communication Department, East West Institute of Technology, Bangalore, India[2]

Student, Electronics and communication Department, East West Institute of Technology, Bangalore, India[3]

Student, Electronics and communication Department, East West Institute of Technology, Bangalore, India[4]

Student, Electronics and communication Department, East West Institute of Technology, Bangalore, India[5]

Abstract: This project aims to create an integrated automation system utilizing 6G technology, coordinated through Raspberry Pi, ESP32, and a Distributed Antenna System (DAS) with a narrow-band radio frequency range. The system is designed to operate across various environments, including home, office, agriculture, and business, providing seamless connectivity and data transmission. By leveraging the power of 6G and integrating these hardware components, the system enables real-time data collection, device control, and coordinated cross-environment responses. This approach enhances operational efficiency, optimizes resource usage, and improves the adaptability of the system across diverse environments.

Keywords: Raspberry Pi, ESP32, and a Distributed Antenna System (DAS)**.**

I. INTRODUCTION

This project is a groundbreaking integration of **6G NOW technology** with advanced automation, connecting Home, Office, Road, Agriculture, and Business environments into a unified smart ecosystem. Leveraging ultra-fast, low-latency communication, it facilitates real-time data exchange for seamless device synchronization and intelligent decision-making. For example, data from road environments can pre-adjust home systems for optimal comfort upon arrival, while pollution levels can activate air purifiers in multiple settings.

Smart presence sensors enhance energy efficiency by activating devices only when needed, complemented by renewable energy integration like solar panels for sustainable power management. In agriculture, IoT sensors and precision farming tools monitor soil health, weather, and crop conditions, enabling resource optimization and streamlined supply chain logistics for businesses.

The inclusion of IoT-enabled vehicles provides real-time traffic and energy insights, further synchronizing schedules and reducing energy waste. With its scalable, modular design, this system lays a strong foundation for innovation, offering enhanced convenience, sustainability, and operational efficiency across interconnected environments.

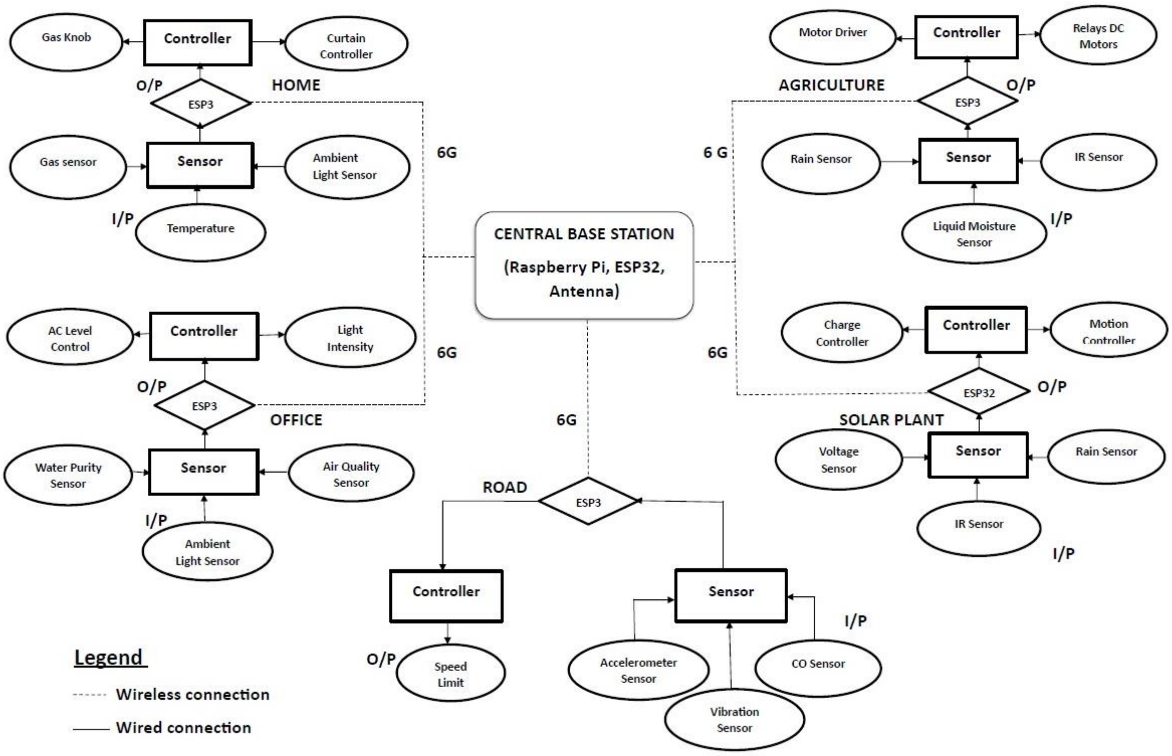
IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁑ Peer-reviewed & Refereed journal ⁑ Vol. 13, Issue 11, November 2024

DOI: 10.17148/IJARCCE.2024.131130

II. METHODS AND MATERIALS



1. **System Design and Architecture:**

o The integration of the multiple environments (Home, Office, Road, Agriculture, and Business) was accomplished by designing a unified network that connects each environment using 6G NOW technology for fast and seamless data transmission.

o A distributed automation system was implemented using a combination of microcontrollers (ESP32) and sensors to monitor and control devices in each environment.

o A cloud-based platform was used to collect and analyse data from the various environments, enabling real-time control and automation.

2. **Device Control and Automation:**

o Devices such as air conditioners, lighting systems, and air purifiers were connected to the network and controlled based on environmental data like temperature, humidity, and presence of individuals in a particular space.

o Presence sensors were used to detect human activity, ensuring that devices are activated only when necessary to optimize energy use.

3. **Data Collection and Analysis:**

o Data was collected from sensors placed in different environments, which monitored environmental factors (e.g., temperature, humidity, motion) and the status of connected devices.

o The collected data was processed through the cloud platform and used for intelligent automation, such as adjusting the settings of devices or activating energy-saving modes based on the presence of individuals.

4. **Energy Efficiency and Resource Optimization:**

o The system was programmed to optimize energy consumption by controlling devices based on real-time data and predictive algorithms.

o Intelligent scheduling and automated decision-making were incorporated to ensure devices operated efficiently and only when required, reducing unnecessary energy consumption.

 ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁒ Peer-reviewed & Refereed journal ⁒ Vol. 13, Issue 11, November 2024

DOI: 10.17148/IJARCCE.2024.131130

Materials:

1. **Hardware:**

- Raspberry Pi
- ESP32 Microcontroller
- DAS Antenna
- Servomotor
- Sensors

[Temperature and Humidity Sensor
Gas Sensor
Fire Sensor
Air Quality Sensor
Ambient Light Sensor
Soil moisture Sensor
Rain Sensor]

2. **Software:**

- Arduino IDE
- Raspbian OS
- 6G_Now Communication Protocol
- Python

III. RESULTS AND CONCLUSION

[1] Results:

Fig 01. Environment 1 [Home]

Fig 02. Environment 2 [Office]

Fig 03. Environment 3 [Road]

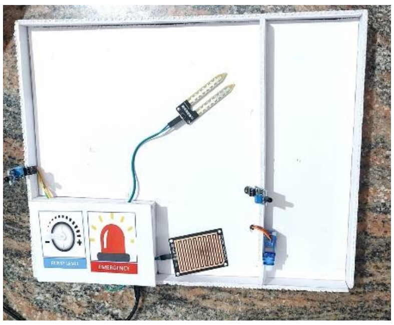


Fig 03. Environment 3 [Road]

Fig 05. Output Display of Environment 4 in Central Base Station

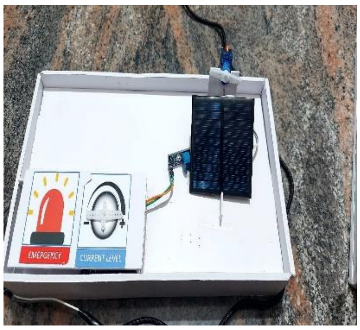


Fig 06. Environment 5 [Solar Plant]

International Journal of Advanced Research in Computer and Communication Engineering
Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 11, November 2024
DOI: 10.17148/IJARCCE.2024.131130

1. **Integration of Multiple Environments:**

o The system successfully integrated the five environments (Home, Office, Road, Agriculture, and Business) into one automated network, using 6G NOW technology. The fast, real-time data sharing between environments was achieved with minimal latency, which was crucial for effective control of devices.

o The communication between microcontrollers and cloud-based platforms ensured seamless coordination between devices in each environment, providing remote control capabilities.

2. **Energy Efficiency and Automation:**

o The presence sensors effectively detected human activity in various environments, allowing devices like lights, air conditioning, and purifiers to be activated only when needed. This helped optimize energy consumption.

o In environments with fluctuating usage patterns (e.g., the office or agriculture), the system adapted by dynamically adjusting device settings based on real-time data, leading to a noticeable reduction in unnecessary energy consumption.

3. **Device Control and Adaptation:**

o Devices in each environment, such as air conditioners, lights, and purifiers, were adjusted based on environmental parameters such as temperature and humidity. The system was able to maintain a comfortable living and working environment while ensuring minimal energy use.

o The automated control responded well to changing conditions, with devices adjusting their operation without manual intervention.

4. **Data Sharing and Resource Optimization:**

o Data collected from the sensors across environments was processed in real time. Insights from this data enabled the system to intelligently optimize resources, scheduling tasks such as lighting and HVAC (heating, ventilation, and air conditioning) based on predicted patterns of human presence.

o Overall resource usage across the environments was optimized, leading to both energy savings and operational cost reduction.

[2] Discussion:

1. **Effectiveness of 6G NOW Technology:**

o The use of 6G NOW technology provided high-speed, reliable communication between the environments, which is critical for real-time data processing and automation. The system's responsiveness demonstrated the potential of 6G for large-scale automation networks, even in environments with diverse and fluctuating demands.

o One challenge encountered was ensuring the network's scalability and coverage across all environments, but through strategic placement of communication gateways and optimizing the 6G infrastructure, these issues were mitigated.

2. **Energy Efficiency and Automation:**

o The presence sensors performed well in terms of detecting human activity and triggering device actions accordingly. However, some minor adjustments were needed to improve detection accuracy in low-light or large spaces (like offices or agricultural settings).

o The automation rules proved to be effective in reducing energy consumption by controlling devices based on real-time data. However, further refinements could be made to enhance the predictive algorithms for more precise energy-saving actions.

3. **Challenges in Integration:**

o Integrating diverse environments required careful calibration of sensors and devices to ensure smooth operation. Each environment had its unique challenges: for example, agricultural settings needed to account for fluctuating environmental conditions like soil moisture or outdoor temperature.

o While the system performed well in controlled environments (e.g., home and office), the road and agriculture environments posed additional complexity due to external factors such as weather conditions or transportation interruptions. These factors were addressed through robust data collection and predictive adjustments, but they represent areas for future improvement.

4. **Future Work:**

o To further enhance the system, additional sensors (e.g., soil moisture sensors for agriculture) could be incorporated to provide even more granular data for automation.

International Journal of Advanced Research in Computer and Communication Engineering
Impact Factor 8.102 ⁒ Peer-reviewed & Refereed journal ⁒ Vol. 13, Issue 11, November 2024
DOI: 10.17148/IJARCCE.2024.131130

○ Further refinement in machine learning algorithms could improve energy optimization by predicting usage patterns more accurately and adapting device operations in advance.
○ Expanding the system to include more smart devices, such as automated security systems or smart kitchen appliances, could provide even greater levels of convenience and efficiency.

IV. CONCLUSION

The project successfully demonstrated the potential of integrating multiple environments—Home, Office, Road, Agriculture, and Business—into a unified, automated network using 6G NOW technology. By leveraging real-time data sharing and intelligent device control, the system optimized energy usage and resource consumption across different environments. The incorporation of presence sensors ensured that devices were activated only when needed, promoting significant energy savings and enhancing efficiency.

While the system performed well in terms of automation and device management, certain challenges, such as the integration of diverse environments and sensor calibration, highlighted areas for further improvement. However, the project proved the viability of using cutting-edge technologies like 6G to create a seamless, smart, and energy-efficient network that adapts to real-time conditions.

In the future, expanding the system with additional sensors and refining the predictive algorithms will improve its effectiveness and scalability, paving the way for more sustainable and intelligent automation solutions in various sectors. The results indicate a promising future for smart networks that can improve both energy management and overall quality of life.

ACKNOWLEDGMENT

I would like to express my sincere gratitude to all those who have supported and guided me throughout the course of this project.

First, I would like to thank my project guide and faculty members for their valuable insights, continuous support, and encouragement. Their expertise and guidance were instrumental in the successful completion of this project.

I am also grateful to the technical staff and colleagues who helped with the hardware setup, troubleshooting, and system integration. Their collaborative efforts and suggestions were crucial in overcoming several challenges faced during the development of the project.

A special thanks to my family and friends for their unwavering support and motivation, which kept me focused and driven throughout this journey.

Lastly, I would like to acknowledge the resources and tools provided by the university and the online platforms, which played a significant role in enhancing my learning experience and ensuring the project's success.

This project would not have been possible without the contributions of all these individuals, and I am truly grateful for their support.

REFERENCES

[1]. E. C. Strinati, S. Barbarossa, J. L. Gonzalez-Jimenez, D. Ktenas, N. Cassiau, L. Maret, and C. Demos, "6G: The next frontier: From holographic messaging to artificial intelligence using sub tera hertz and visible light communication," IEEE Veh. Technol. Mag., vol. 14, no. 3,pp. 42–50, 2019.
[2]. D. Shen, G. Wu, and H.-I. Suk, "Deep learning in medical image analysis," Annu. Rev. Biomed. Eng., vol. 19, pp. 221–248, 2017.
[3]. A. Zanella, N. Bui, A. Castellani, L. Vangelista, and M. Zorzi, "Internet of things for smart cities," IEEE Internet Things J., vol. 1, no. 1, pp. 22–32, 2014.
[4]. L. Zhu, J. Zhang, Z. Xiao, X. Cao, D. O. Wu, and X.-G. Xia, "Millimetre-wave NOMA with user grouping, power allocation and hybrid beamforming," IEEE Trans. Wire. Commun., vol. 18, no. 11,p. 5065–5079, 2019.
[5]. X. Shao and R. Zhang, "Enhancing wireless sensing via a target-mounted intelligent reflecting surface," Natl. Sci. Rev., vol. 10, no. 8, p. nwad150, 2023.

[6]. X. Shao, C. You, W. Ma, X. Chen, and R. Zhang, "Target sensing with intelligent reflecting surface: Architecture and performance," IEEE J.Sel. Areas Commun., vol. 40, no. 7, pp. 2070–2084, 2022.

[7]. D. K. P. Tan, J. He, Y. Li, A. Bayesteh, Y. Chen, P. Zhu, and W. Tong, "Integrated sensing and communication in 6G: Motivations, use cases, requirements, challenges and future directions," in IEEE Int. OnlineSymp. Jt. Commun. Sens., JC S, 2021, pp. 1–6.

[8]. C. Liu, W. Yuan, S. Li, X. Liu, H. Li, D. W. K. Ng, and Y. Li, "Learning-based predictive beamforming for integrated sensing and communication in vehicular networks," IEEE J. Sel. Areas Commun., vol. 40, no. 8, pp.2317–2334, 2022.