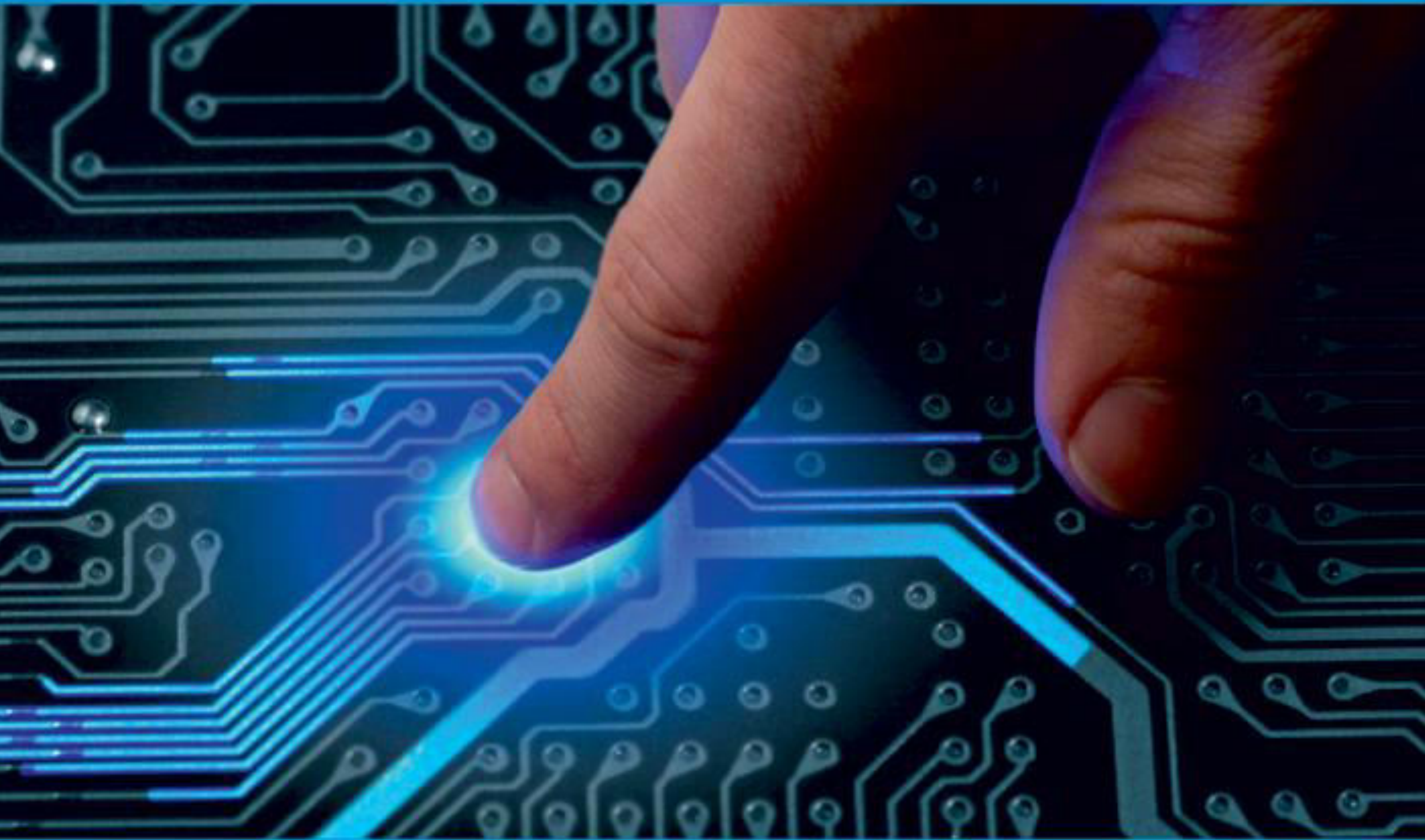
IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 11, Issue 11, November 2023

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.379

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 || A Monthly Peer Reviewed & Referred Journal |

|| Volume 11, Issue 11, November 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1111045 |

UNMANNED DEFENCE VEHICLE

Prajwal V, U.B.Mahadevaswamy

PG Student, Dept. of E&C, Sri Jayachamarajendra College of Engineering, Mysore, Karnataka 570018, India

Professor & Head, Dept. of E&C., Sri Jayachamarajendra College of Engineering, Mysore, Karnataka 570018, India

ABSTRACT: Unmanned Ground Vehicles (UGVs) have emerged as versatile, autonomous or semi-autonomous vehicles designed for a wide range of ground-based operations. These machines are equipped with advanced sensors, autonomous control systems, and robust mobility platforms that allow them to navigate challenging terrains, collect data, and execute complex missions with precision. Recent technological advancements, including machine learning and artificial intelligence, have further improved UGVs' autonomy and adaptability, making them invaluable across various sectors, from military applications to agriculture, logistics, and autonomous transportation. UGVs' multifaceted capabilities are transforming industries by increasing efficiency and safety while reducing the need for human intervention in hazardous or repetitive tasks. As battery technology and propulsion systems continue to evolve, UGVs are poised to play a pivotal role in the future of automation and robotics. These versatile machines are set to make a lasting impact on modern society, offering promise in addressing an array of challenges and opportunities across diverse fields.

KEYWORDS: Unmanned defence/Ground vehicles(UDVs/UGVs):Arduino uno R3 Developer:

I. INTRODUCTION

The rapid advancement of technology and computing capabilities presents significant opportunities for the development of innovative robot control systems. These technological strides, coupled with the demand for high performance robots, have given rise to faster, more precise, and intelligent robotic systems employing novel controllers, advanced drives, and cutting-edge control methodologies. This project introduces a novel approach to managing robotics through a wired network. Traditional robot control systems require reprogramming when project parameters change, which can be time-consuming and lacks user-friendliness. To enhance user control and streamline robot operations, modern technology is harnessed. To address this need, a dedicated mobile application has been developed for the remote control of an embedded robot. This application facilitates seamless control of the robot's movements. The embedded hardware utilizes an 8051 microcontroller, controlled through an Android-based smartphone interface. The 8051 controller receives commands via AT commands transmitted from the smartphone. It processes this data to manage the robot's motors through an L293D motor driver, enabling various movements such as forward, backward, left, right, and more. The smartphone establishes a wireless connection with the embedded device via Bluetooth technology. Furthermore, the 8051 microcontroller is equipped with an HC-05 Bluetooth module, which allows it to receive commands wirelessly from the smartphone. Additionally, the robot is equipped with a wireless camera, enabling infrared observation even in lowlight conditions. In summary, this project harnesses contemporary technology to provide a user-friendly and efficient means of controlling robots. It employs a dedicated mobile application and a sophisticated hardware setup, including an Arduino uno R3 development board microcontroller, Bluetooth connectivity, and a wireless camera, to empower users in managing robot operations effectively.

II. LITERATURE SURVEY

A literature review on Unmanned Ground Vehicles (UGVs) encompasses various aspects of research and development in this field, including applications, technologies, challenges, and advancements. Here's an overview of the key themes found in such a review: 1. Historical Development: Understanding the historical evolution of UGVs, dating back to their early military applications and their subsequent adoption in civilian contexts, such as agriculture and logistics. 2. Applications: Examining the diverse applications of UGVs in areas like military, agriculture, search and rescue, mining, and environmental monitoring. 3. Sensing and Perception: Reviewing the role of sensors and perception systems, including LiDAR, cameras, radar, and GPS, in enabling UGVs to navigate and interact with their environments. 4. Navigation and Autonomy: Investigating the development of navigation algorithms and autonomy, which allow UGVs to plan routes, avoid obstacles, and make intelligent decisions. 5. Communication and Connectivity: Analysing the importance of communication systems for remote control and data exchange in UGV

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 || A Monthly Peer Reviewed & Referred Journal |

|| Volume 11, Issue 11, November 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1111045 |

operations. 6. Challenges and Limitations: Identifying the key challenges, such as obstacle detection, power supply, human robot interaction, and legal and ethical issues, that UGVs face in various applications. 7. Technological Advancements: Discussing recent technological advancements, such as the integration of AI, machine learning, and edge computing, that have enhanced UGV capabilities. 8. Human-Robot Collaboration: Investigating how UGVs are designed to collaborate with human operators or work alongside other robots in various scenarios. 9. Security and Ethical Considerations: Addressing the ethical and legal dilemmas raised by the use of UGVs, especially in military contexts. 10. Future Trends and Research Gaps: Identifying emerging trends and areas of future research, such as swarming UGVs, energy-efficient designs, and improved human-robot interfaces. In a comprehensive literature review, each of these themes would be explored in detail, with a focus on recent studies, findings, and the state of the art in UGV research and development.

III. PROPOSED ALGORITHM

Arduino UNO R3 Development board is used for robots. The Bluetooth module is connected to Arduino board. The Android application connects with the Bluetooth module on the Arduino board. After the connection is successful, the user control messages from the GUI of the Android application. The Bluetooth module receives the command sent from the mobile application and sends it to the Arduino UNO R3 board over the communication link. System Architecture is shown in fig

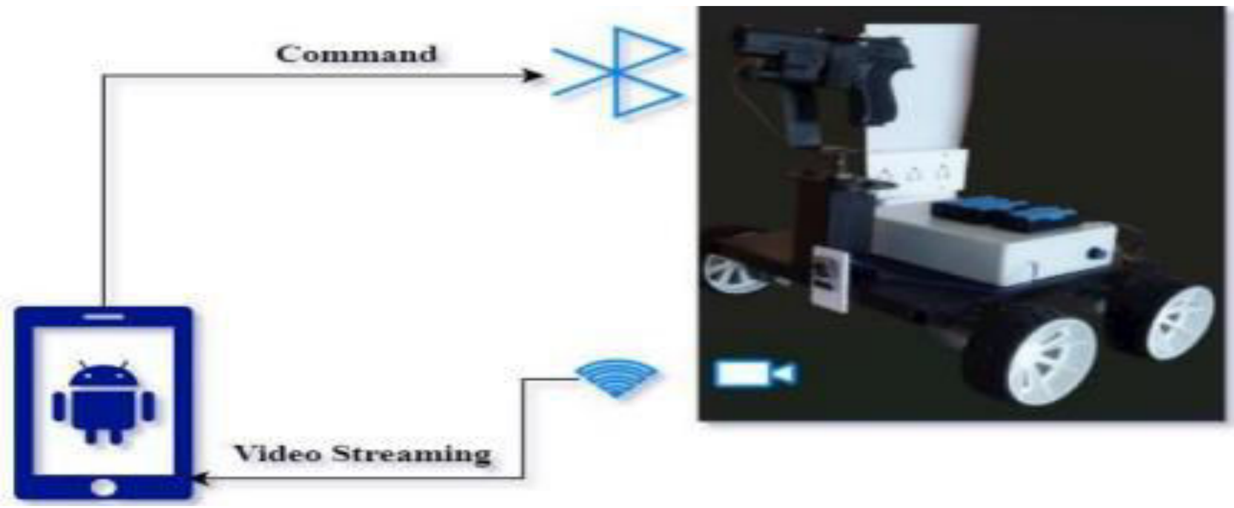


Fig 1: System architecture.

The robot in this project can move in all four directions and the weapon we are using gun in this case can also move in all x y z directions. The circuit is built around the Arduino uno r3 board, Bluetooth module HC 05, motor driver L298N Dual H bridge motor. The Buck Converter uses 2 batteries. DC motors M1 and M2 and some accessories. This circuit uses two 9V batteries. The first battery is used to power the ARDUINO UNO R3 controller board and the other is used to power the motor. Regulated 5V power for the rest of the circuit is provide d by the ARDUINO UNO R3 controller board itself. LEDs on the board indicate power. The Hybridge driver I s used to drive two motors powered by a 9v DC battery. The DC motor is connected to the microcontroller er. The data received from the Android smartphone by the Bluetooth module is fed to the controller as input.

IV. METHODOLOGY

Step 1 The methodology for developing and operating Unmanned Défense Vehicles (UDVs) encompasses various stages, from design and development to deployment and maintenance. Here is a general methodology for UDVs: 1. Needs Assessment and Mission Definition: -Identify the specific defence or security mission or task that the UDV will address. -Determine the operational requirements, objectives, and constraints. -Understand the environment and conditions in which the UDV will operate. 2. Concept Development: -Create a concept of operations (CONOPS) that outlines how the UDV will be used in the mission. -Define the roles and responsibilities of human operators and the UDV. -Identify the required capabilities, such as mobility, payload, and autonomy. 3. Design and Development: -

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 || A Monthly Peer Reviewed & Referred Journal |

|| Volume 11, Issue 11, November 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1111045 |

Develop a detailed design for the UDV, considering efficiency, architecture, and technology. - Select appropriate components, sensors, propulsion systems, and communication hardware. - Implement a modular architecture for flexibility and scalability. - Integrate advanced technologies, such as AI, sensor fusion, and communication protocols. 4. Prototyping and Testing: - Build a prototype or initial version of the UDV for testing and validation. - Conduct rigorous testing, including field tests, to ensure the vehicle meets performance and safety standards. - Address design flaws, software bugs, and other issues identified during testing. 5. Operational Training: - Train human operators in the use of the UDV, including remote operation, mission planning, and troubleshooting. - Ensure that operators understand the capabilities and limitations of the UDV. 6. Deployment and Mission Execution: - Deploy the UDV for operational missions based on the defined CONOPS. - Monitor the UDV's performance during missions and make real-time adjustments if necessary. - Ensure the safety and security of the UDV in hostile or sensitive environments. 7. Data Collection and Analysis: - Gather data from the UDV's sensors and communication systems during missions. - Analyse the data to provide valuable insights, intelligence, and situational awareness to decisionmakers. 8. Maintenance and Upkeep: - Establish a regular maintenance schedule to ensure the UDV remains in optimal condition. - Conduct software updates and hardware replacements as needed. - Keep the UDV's cybersecurity measures up to date to prevent unauthorized access. 9. Feedback and Iteration: - Collect feedback from operators and stakeholders after each mission. - Use this feedback to identify areas for improvement and iterate on the design and operation of the UDV. 10. Ethical and Legal Compliance: - Ensure that the UDV's operations comply with international laws and ethical standards, especially in military contexts. - Address ethical considerations, including rules of engagement and the use of force. 11. Documentation and Reporting: - Maintain comprehensive documentation of the UDV's design, operation, and performance. - Generate reports on mission outcomes, lessons learned, and areas for improvement. 12. Continual Research and Development: - Stay up to date with advancements in technology and robotics for potential integration into UDV capabilities. - Explore opportunities for new applications and missions. The methodology for UDVs is a dynamic and evolving process that requires ongoing attention to technological advancements, operational requirements, and ethical considerations. It aims to ensure the successful development and deployment of UDVs in defence and security operations.

V. WORKING

The working of Unmanned Défense Vehicles (UDVs) involves a multifaceted process where these autonomous or remotely operated vehicles fulfill specific defence and security missions. Typically, UDVs are equipped with advanced sensors and communication systems that provide real-time data and situational awareness to human operators or autonomous decision-making algorithms. They navigate through various terrains, obstacles, and challenging environments using integrated mobility systems. Depending on their mission, they can engage in tasks like reconnaissance, surveillance, combat support, logistics, search and rescue, or explosive ordnance disposal. UDVs are capable of making informed decisions, reacting to changes in the operational environment, and executing tasks autonomously or under human supervision. The collected data and mission outcomes are then transmitted for analysis and decision-making by military or security personnel. The working of UDVs hinges on their ability to enhance mission effectiveness while reducing risks to human operators in complex and often hazardous situations.

Fig 2: Working model

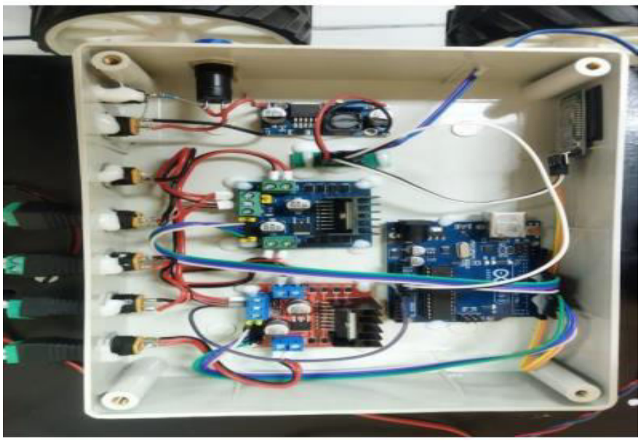


Fig 3: Inner architecture of the working model.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 || A Monthly Peer Reviewed & Referred Journal |

|| Volume 11, Issue 11, November 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1111045 |

VI. RESULTS AND DISCUSSION

The results and discussion of Unmanned Défense Vehicles (UDVs) typically revolve around their performance, impact, and potential for improvement in defence and security applications. Here is an overview of what results and discussions in the context of UDVs may entail: Results: 1. Operational Performance: Evaluation of how well the UDV performed in various missions, including reconnaissance, surveillance, combat, logistics, and more. This includes metrics like mission success rates, response times, and data quality. 2. Efficiency and Endurance: Assessing the energy efficiency and endurance of UDVs, including their range, battery life, and overall operational efficiency. 3. Safety and Reliability: Analysing safety measures and the reliability of UDVs in different scenarios, addressing issues related to autonomous decision-making and remote operation. 4. Technology Integration: Highlighting the success and limitations of integrating advanced technologies, such as AI, sensors, communication systems, and autonomous navigation. 5. Data Collection and Analysis: Presenting the data collected during missions, demonstrating the information's value and how it enhances situational awareness for decision-makers. Discussion: 1. Performance Optimization: Discussing ways to enhance UDV performance by addressing design flaws, software updates, or hardware improvements based on the results obtained. 2. Operational Challenges: Delving into the challenges faced during missions, including terrain-specific difficulties, unexpected obstacles, and technical issues that may have arisen. 3. Ethical and Legal Considerations: Engaging in discussions about the ethical and legal aspects of UDV use, such as rules of engagement, compliance with international laws, and ethical standards in combat situations. 4. Interoperability: Considering how UDVs interact with other military systems and assessing their effectiveness in a broader operational context. 5. Human-Machine Interaction: Examining the role of human operators, their training, and how well they interact with UDVs in various scenarios. 6. Future Directions: Discussing potential areas for improvement and future developments in UDVs, such as increased autonomy, advanced sensors, or innovative mission applications. In summary, the results and discussions regarding UDVs are critical for assessing their real-world performance, identifying areas for improvement, and ensuring that they align with ethical and legal standards in defence and security applications. These discussions provide a valuable framework for continual research and development in the field of UDVs.

REFERENCES

1. An Enhanced LiDAR Inertial Localization and Mapping System for Unmanned Ground Vehicles ‘by Kangcheng Liu∗, Xunkuai Zhou, and Ben M. Chen (Published in 2022).
2. Optimal Unmanned Ground Vehicle—Unmanned Aerial Vehicle Formation-Maintenance Control for Air-Ground Cooperation “by Jingmin Zhang 1,2, Xiaokui Yue 1*, Haofei Zhang 2 and Tiantian Xiao 2 (Published on a article in 2022).
3. “Integrated robust dynamics control of all-wheel-independently actuated unmanned ground vehicle in diagonal steering “ by Yutian Zhang ,Jun Ni *, Hanqing Tian , Wei Wu , Jibin Hu (Published in 2022) .
4. Formation control and coordination of multiple unmanned ground vehicles in normal and faulty situations” by Mohamed A. Kamel a , Xiang Yu b , Youmin Zhang.
5. An overview of autonomous crop row navigation strategies for unmanned ground vehicles” by Stephanie Bonadiesa,1, S. Andrew Gadsdenb.
6. “Usability of Perception Sensors to Determine the Obstacles of Unmanned Ground Vehicles Operating in Off-Road Environments” By Marek Nowakowski * and Jakub Kurylo (Published in a article on 2023).
7. Identification and Control of An Unmanned Ground Vehicle by Using Arduino” by Marco C. DE SIMONE1 and Domenico GUIDA2.
8. Mapping forests using an unmanned ground vehicle with 3D LiDAR and graph-SLAM” by Marek Pierzchałaa,∗, Philippe Giguèreb, Rasmus Astrupa.
9. Experiments in unmanned aerial vehicle/unmanned ground vehicle radiation search” by John Peterson1 | Weilin Li2 | Brian Cesar- Tondreau3 | John Bird1 | Kevin Kochersberger1 | Wojciech Czaja2 | Morgan McLean4 (Published on field report on the year 2019).Mr. Rajesh H. Davda1, Mr. Noor Mohammed, “ Text Detection, Removal and Region Filling Using Image Inpainting”, International Journal of Futuristic Science Engineering and Technology, vol. 1 Issue 2, ISSN 2320 – 4486, 2013.
10. Configurations and Applications of Multi-Agent Hybrid Drone/Unmanned Ground Vehicle for Underground Environments” by Chris Dinelli 1, John Racette 1, Mario Escarcega 1, Simon Lotero 2, Jeffrey Gordon 2, James Montoya 1, Chase Dunaway 1, Vasileios Androulakis 2 , Hassan Khaniani 3 , Sihua Shao 4 , Pedram Roghanchi 2 and Mostafa Hassanalian .

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 || A Monthly Peer Reviewed & Referred Journal |

|| Volume 11, Issue 11, November 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1111045 |

11. A Global Path PlanningMethod for Unmanned Ground Vehicles in Off-Road Environments Based onMobility Prediction" by Chen Hua 1,2, Runxin Niu 1, Biao Yu 1,* , Xiaokun Zheng 1,2, Rengui Bai 1,2 and Song Zhang (Published on a article in the year 2022).
12. Towards the Unmanned Aerial Vehicles (UAVs) by Syed Agha Hassnain Mohsan 1 , Muhammad Asghar Khan 2 , Fazal Noor 3 , Insaf Ullah 2 and Mohammed H. Alsharif 4 (Published on the review paper in the year 2022).
13. Modified FMCW Scheme for Improved Ultrasonic Positioning and Ranging of Unmanned Ground Vehicles at Distances < 50 mm" by Stefano Laureti 1,* , Marco Mercuri 1 , David A. Hutchins 2 , Felice Crupi 1 and Marco Ricci.
14. Effective Motion Sensors and Deep Learning Techniques for Unmanned Ground Vehicle (UGV)-Based Automated Pavement Layer Change Detection inRoad Construction" by Tirth Patel 1,*, Brian H. W. Guo 1, Jacobus Daniel van der Walt 1 and Yang Zou.
15. Collaborative Remote Control of Unmanned Ground Vehicles in Virtual Reality" by Ziming Li, Yiming Luo, Jialin Wang, Yushan Pan, Lingyun Yu, Hai-Ning Liang (Published in IEEE on the year 2022).

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING