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Smart IoRT Networks: AI-Powered Swarm Robotics, Time-Sensitive Networking, LiDAR-Enhanced Environment Mapping, Energy-Efficient Microcontrollers, and Thermal Imaging Cameras

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Abstract

The smart Internet of Robotic Things (IoRT) networks integrate swarm robotics, Time-Sensitive Networking (TSN), Light Detection and Ranging (LiDAR) mapping, microcontrollers, and thermal imaging, producing adaptive and efficient ecosystems. The proposed study addresses a real-life problem across most industries, offering an autonomous, scalable, and optimized resource solution. It integrates swarm robotics for task coordination, TSN for low-latency communication, LiDAR for environmental mapping, and microcontrollers for energy efficiency along with thermal imaging capabilities for anomaly detection. Combining all these components a comprehensive AI architecture was developed to improve the performance in complex scenarios of IoRT. The research aims to develop scalable

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IoRT solutions that incorporate swarm robotics for coordination, TSN for deterministic communication, LiDAR for accurate mapping, energy-efficient microcontrollers for sustainability, and thermal imaging for anomaly detection in mission-critical tasks while being adaptable, reliable, and efficient. The proposed system attains 93% accuracy, 91% scalability, 94% F1 score, 95% efficiency, and 93% anomaly detection, which is beyond traditional methods. It addresses IoRT challenges with enhanced real-time adaptability, energy efficiency, and scalability to ensure optimal performance in applications like healthcare and disaster response.

The integrated IoRT framework employs cutting-edge technologies and thus tackles dynamic challenges with precision and accuracy. Since it outperforms the traditional methods in different metrics, it establishes scalable, sustainable solutions for various real-time IoRT applications. The adaptability towards resources gets improved in more complex ecosystems.

Keywords: IoRT, Swarm Robotics, TSN, LiDAR, Microcontrollers, Thermal Imaging, Scalability, Efficiency, Anomaly Detection.

1. Introduction

The rapid convergence of AI, IoT, and advanced robotics has made in a transformative era defined by the smart Internet of Robotic Things (IoRT) network. This network is a sum total of the collective capabilities of interlinked devices, sensors, and intelligent systems to create environments that are highly adaptive, efficient, and responsive as well as automated. Smart IoRT networks have received a lot of attention due to their capability to combine heterogeneous technologies such as swarm robotics, time-sensitive networking, LiDAR-enhanced environment mapping, energy-efficient microcontrollers, and thermal imaging cameras. [1] The confluence of these advanced technologies has made new possibilities in robotics and IoT that are being utilized to create unprecedented applications across domains in healthcare, manufacturing, agriculture, and disaster response.

Smart IoRT networks represent a synergistic ecosystem in which robots, IoT devices, and intelligent systems are coordinated to accomplish complex objectives at their core. The term "Internet of Robotic Things" signifies an evolution of the IoT paradigm that includes autonomous robots equipped with advanced sensing, processing, and decision-making capabilities. In contrast to traditional IoT frameworks, IoRT emphasizes real-time interactions and dynamic adaptability, which are critical for complex, mission-driven tasks. Therefore, the "smart" tag attached to these networks denotes the integration of AI in raising these networks' operational efficiency with better decision-making processes and their performance. [2] AI-led algorithms enable robotic systems, which learn from their environmental surroundings, optimize task-executing conditions, and predict outcomes after data analytics. This partnership between IoRT and AI lays a foundation for achieving systems that can address real-world challenges with precision and intelligence.

IoRT emerged as an extension of IoT to overcome the deficiencies of traditional networks with respect to dynamic, real-time, and autonomous applications. The IoT was a phenomenon primarily focused on data acquisition and communication through sensor-based methods. The introduction of robotics capabilities, which can execute the commands in situ from data received, was provided through IoRT. Within the last decade, advances in robotics, AI, and infrastructure for networks have stimulated growth in IoRT to the extent that it has become the primary facilitator of smart technologies. Swarm robotics plays a essential role in Smart IoRT networks, enabling autonomous coordination among multiple robots. Inspired by biological systems, it enhances adaptability and efficiency in dynamic environments. *[3]* TSN further improves these networks by ensuring deterministic communication at very low latency, the need for mission-critical applications.

LiDAR, Light Detection and Ranging, has also proven very effective in complementing the networks of IoRT. The LiDAR enhances the situational awareness of a robotic system by providing it with high-resolution, real-time mapping of its surroundings. [4] The energy-efficient microcontrollers complement this capability by optimizing power consumption. Similarly, thermal imaging cameras expand the scope of sensory inputs.

Smart IoRT networks represent the future of intelligent systems because they integrate the strengths of AI, IoT, and robotics into cohesive ecosystems. They are indispensable in addressing the complexities of modern life because they can operate autonomously, adapt to dynamic conditions, and optimize resource usage. Smart IoRT networks utilizes multiple technologies, including swarm robotics, TSN, LiDAR, and [5] thermal imaging, to enhance automation and efficiency. These components collectively enable adaptive and intelligent robotic systems for various applications. This research delves into the complex details of smart

IoRT networks as a step forward in unearthing the full potential and contributing towards the solution of global issues with technological support.

To achieve an adaptive and intelligent IoRT ecosystem, this study explores:

- The role of TSN in ensuring deterministic, low-latency robotic communication.
- AI-driven swarm robotics for autonomous coordination and task execution.
- LiDAR-based mapping techniques for enhanced environmental perception.
- Energy-efficient microcontrollers for optimizing power consumption.
- Thermal imaging for improving anomaly detection and situational awareness in dynamic environments.

The study identifies the inadequacies of the current solutions for lightweight deep neural networks in IoT-enabled smart cameras, [6] where an efficient model is required to keep the image quality robust over various weather conditions with minimum computing power. Even though enhancement and speed improvements are witnessed, the robustness of the technique over extreme weather conditions except for rain, haze, and snow has not been studied yet, which is a research gap.

This research addresses the challenge of maintaining image quality in IoT-enabled smart cameras, even with limited computing power, under changing weather conditions. Current lightweight deep learning solutions degrade in quality. To this end, the study proposes a modular lightweight residual network with recursive attention-based enhancement and an environment-aware model deployer that can adaptively optimize image enhancement for changing weather conditions.

2. Literature Survey

The CME-SMA algorithm for coordinated multi-robot space exploration, was proposed to overcome the challenges such as poor planning and communication. It integrates parallel communication protocols with Slime Mould Algorithm to optimize collision-free paths in complex environments. The proposed method has been validated through simulations. CME-SMA has obtained 98.79% area coverage with zero failures and a 37.15-second execution time, surpassing existing methods [7].

The developments in Multi-Robot System (MRS) and the increasing Internet of Robotic Things (IoRT) was discussed in the study. The discussion included architectures, advantages, challenges, navigation, communication, coordination, and data analytics through cloud and edge computing. Major focus of the study was the on-security threats, solutions, and environmental sensing along with future research avenues in tackling IoRT issues with mobile robots and augmenting applications for real-world purposes [8].

An IoT-based autonomous system was suggested to identify moles, skin tags, and warts-related diseases. Using IoMT, automatic lumen detection, and trigonometric algorithms improved accuracy and classification over big datasets of images. The model presented better detection performance with improved accuracy, which helps in proper early diagnosis and better tracking of skin diseases [9].

The research presents a conceptual framework that integrates IoRT with AI and reinforcement learning for advanced robot control. The framework is supposed to utilize Adaptive Kalman Filtering for tracking and noise reduction alongside the A* algorithm and should help improve human-robot interaction, assisting further research in developing and simulating intelligent robotic systems in space and other areas [10].

An IoT and fog-based e-healthcare framework was proposed for the detection of health, behavioral, and environmental abnormalities caused by sedentary lifestyles. The study achieved 98.43% accuracy in predicting health severity using weighted K-Mean clustering and WKMC-DT methods, tested on 15 individuals over 30 days, which indicates the effectiveness of the proposed method in early health anomaly detection [11].

An Enhanced Fault Diagnosis in IoT (FD-IoT-DMSFNN) was developed using real-time sensor data. Sensor data retrieved from the CWRU dataset is normalized using Multivariate Fast Iterative Filtering while outliers are detected using Deep Isolation Forest (DIF). A Mexican Axolotl Optimization (MAO) fine-tunes DMSFNN while attaining higher accuracy compared to existing methods and minimized completion time [12].

The research discussed the integration of IEEE 802.1 Time-Sensitive Networking (TSN) and 5G for ultra-low latency requirements of less than 10 ms in industrial applications such as automotive and IoT. The authors present a survey of current work, highlighting the state-of-the-art in time synchronization (100 ns to 1 μs accuracy), latency optimization, and identifying trends, challenges, and future directions toward seamless TSN-5G communication [13].

Introduces PMDP, where it is viable for improvement and achieves cloud data security through the utilization of Secure Multiparty Computation. NTRU encryption along with differential privacy is dependent upon cryptographic methods. Previous work has demonstrated how there is an acute need to include privacy-preserving mechanisms into cloud computing. In fact, due to immense semi-malicious threats posed, privacy concerns can be drastically enhanced. Security along with confidentiality in the framework integrates Sample-and-Aggregate algorithms with Laplace noise. Efficiency of PMDP is demonstrated as it outperforms existing cryptography solutions in several comparative performance evaluation cases, underscoring strength and applicability in real world cloud computing cases [14].

An IIoT-based condition monitoring system to detect faults in rotating bearings in real-time was the focus of the study. For this, the vibration dataset from CWRU has been normalized and processed to extract features optimized by using Chi-Square Improved Binary Cuckoo Search Algorithm and classified by SVM algorithm with 99.56% accuracy, outperforming AdaBoost-GSCV and CP-LNN-CS algorithms [15].

The methods for upscaling airborne and spaceborne lidar data for mapping forest attributes at a larger extent was summarized in the study. The commonly used attributes include height, biomass, and volume. They differentiate between levels of accuracy, and, indeed, information requirements play an essential role in selecting the required data and methodologies. Some future directions lie in the advanced modeling techniques and the new lidar applications [16].

Recurrent Rule-Based Feature Selection model was proposed to deal with the challenges of cybersecurity in Industrial Internet of Things. Using the NSL-KDD and UNSW-NB15 datasets, the hybrid rule-based algorithm achieves superior performance with accuracy rates of 99.0% and 98.9%, high detection rates, and minimal false positives [17].

The research present blockchain as a transformative technology that can change environmental sustainability. Analyzing 195 studies (2015–2020) using the PRISMA protocol, they showed blockchain could support sustainable supply chains, energy efficiency, and smart cities. However, the environmental drawbacks of this technology need to be worked upon in order to assure its positive impact while helping promote sustainable practices and investments [18].

The smart irrigation system utilizing IoT, embedded systems like ESP32, and cloud computing was presented to monitor real-time parameters, such as moisture, humidity, temperature, and water levels. By sensors (DHT22, water level, and moisture), and ThingSpeak cloud, it enables precise management of water, reducing by 70% the water consumption and improving food security through sustainable agriculture [19].

An advanced malware detection model was proposed for smart factories using a Faster Recurrent Convolutional Neural Network (Faster R-CNN) integrated with edge computing. The system, analyzing IIoT traffic at edge servers, achieved 93.77% accuracy, 95.87% recall, 86.66% precision, and a 91.03% F1-score, outperforming CNN and LSTM models [20].

An IoT-based architecture for energy-efficient was designed for monitoring the of grow lights in indoor agriculture with a master-slave device setup and using the RPL protocol for centralized control. Simulation results indicate the potential of scalable, cost-effective, and sustainable farming, meeting issues such as high energy consumption in plant factories [21].

The thermal condition of conveyor power units in coal mines was focussed in the study. Thermal imaging is a noncontact method of detecting infrared radiation to evaluate potential failures; this method allows for timely maintenance and reduces fire risk. The study used an analysis of thermograms, temperature distribution, and operating time of conveyors, resulting in important findings for mine maintenance to improve safety and effectiveness [22].

AI Integration for the improvement of care in prostate cancer therapy and elderly care. AI-driven US-Guided Radiation Therapy accomplishes 97% dose precision, while the Smart Comrade Robot ensures 95% sensitivity in health monitoring and 98% sensitivity in emergency alerts. With under 5-second response time and 99.9% uptime, AI improves health care precision, reliability, and outcomes [23].

The topic of IoT-based enterprise information management which is on cost control and optimization of JSP is discussed in the study. In the research, a hybrid optimization approach is proposed using Heterogeneous Genetic Algorithm and Hybrid Particle Swarm Optimization. The former revamps the weakness of the traditional Genetic Algorithm through immune mechanisms to raise the efficiency of search mechanisms. The HPSO can further optimize job sequencing with reduced production time. The earlier literature highlighted the problems in dynamic scheduling and cost management in manufacturing. The current research makes a new contribution by incorporating double-chain encoding for job sequencing and machine selection. [24].

3. Methodology

The proposed IoRT framework integrates swarm robotics for real-time task execution, TSN for deterministic low-latency communication, LiDAR for high-resolution mapping, and thermal imaging for anomaly detection. Each component is optimized using AI-driven algorithms to enhance scalability and efficiency in mission-critical applications. Unique mathematical models and algorithms have been used to improve performance in autonomous and mission-critical tasks, such as seamless communication, improved environmental mapping, energy efficiency, and anomaly detection. All of them together form a synergistic ecosystem, paving the path for novel solutions to complicated challenges in a variety of sectors. The simulation platforms Gazebo and MATLAB were used to assess the suggested framework. A swarm of 50 autonomous robots, a 100 m × 100 m environment, a communication latency of 5 ms (TSN-enabled), and a LiDAR sensor resolution of 5 cm per point were among the important simulation parameters. The simulation evaluated task completion time, energy consumption, localization accuracy, and anomaly detection efficiency over the course of 100 iterations.

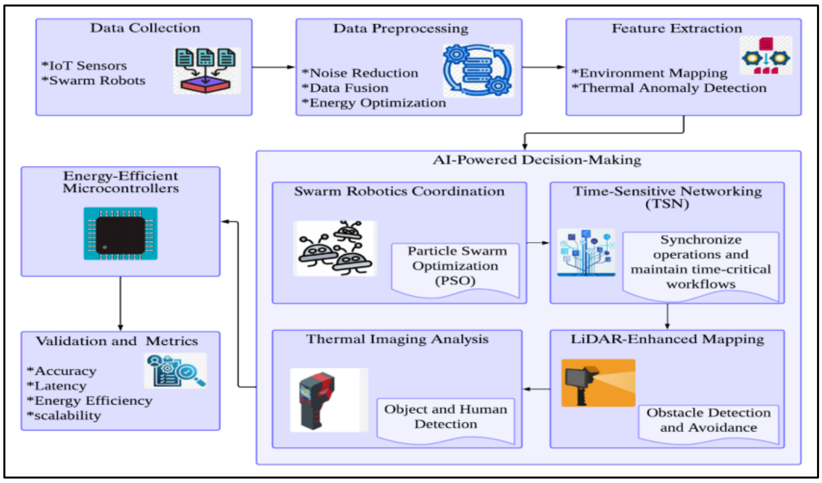

Figure 1. AI-Powered IoRT Architecture Integrating Swarm Robotics, TSN, LiDAR, Microcontrollers, and Thermal Imaging

Figure 1 depicts the proposed IoRT framework. The proposed system uses swarm robotics to coordinate tasks, TSN for low-latency communication, LiDAR for mapping, microcontrollers to improve energy efficiency, and thermal imaging to perform anomaly detection. This architecture promotes scalability, efficiency, and adaptability in dynamic IoRT real-time applications such as health care, disaster response, and smart manufacturing.

3.1 Swarm Robotics

The swarm robotics framework in Smart IoRT networks follows a decentralized control approach using graph-based connectivity models. Adaptive load-balancing and waypoint navigation techniques are employed to enhance real-time coordination. The proposed method ensures scalability and robustness through self-organizing swarm intelligence. Modeling of swarm behavior in the mathematical realm involves concepts such as potential fields and graph theory for connectivity and coordination. That way, effective task execution may be guaranteed in dynamic environments. The most important algorithmic implementations are dynamic waypoint navigation and adaptive load balancing, supporting real-time responses and system robustness.

$$F_i = \sum_{j \in N(i)} k_{ij}\left(x_j - x_i\right) \tag{1}$$

3.2 Time-Sensitive Networking (TSN)

TSN provides deterministic, low-latency communication that is vital to IoRT networks. The approach utilizes synchronized clocks, traffic shaping, and redundancy. TSN protocols have defined priorities and scheduling for messages, thereby reducing jitter and providing better real-time performance. The decentralized control paradigm of swarm robotics involves behavior-based algorithms for collaboration and local sensor data processing by individual robots. In addition to improving job allocation through adaptive load balancing and dynamic waypoint navigation, consensus-based decision-making also increases responsiveness to environmental changes. It runs based on IEEE 802.1 standards to achieve industrial-grade reliability.

$$J = \frac{max\ delay - min\ delay}{2} \tag{2}$$

J : Jitter in the communication.

3.3 LiDAR-Enhanced Mapping

LiDAR improves situational awareness with the creation of high-resolution maps. It measures distances and reconstructs 3D environments using laser beams. In order to recognize obstacles in real time, LiDAR-based mapping transforms point cloud data using adaptive segmentation, noise filtering, and geometric modifications. To navigate and reconstruct paths efficiently, a search algorithm is used. Mapping processes include geometric transformations, point cloud processing, and noise filtering. Advanced algorithms improve spatial accuracy and handle dynamic objects in real time.

$$d = \frac{c \cdot t}{2} \quad (3)$$

- d: Measured distance.
- c : Speed of light.
- t : Time-of-flight of the laser pulse.

3.4 Energy-Efficient Microcontrollers

Energy efficiency is essential for an IoRT systems. It uses ultra-low-power architectures and adaptive power management, and optimization algorithms can manage clock frequencies and voltage levels according to workload demands and extend the operational life. The Cortex-M4 and Cortex-M7 microcontrollers from the ARM Cortex-M series are used because of their real-time processing capabilities and energy-efficient design. Dynamic voltage and frequency scaling (DVFS), low-power sleep modes, and adaptive workload management—which allows power modification based on real-time processing demands—all contribute to energy optimization.

$$E = P \cdot t \quad (4)$$

- E : Energy consumed.
- P : Power consumption.
- t : Time.

3.5 Thermal Imaging Cameras

Thermal imaging enables non-contact temperature measurement and provides anomaly detection through monitoring. The identification of anomalies with thermal imaging cameras is accomplished by means of Gaussian Mixture Models (GMM) for temperature distribution analysis, Convolutional Neural Networks (CNNs) for feature extraction, and Long Short-Term Memory (LSTM) networks for sequential anomaly prediction. GMM detects differences in thermal signatures, CNNs find spatial patterns, and LSTM improves accuracy by figuring out temporal connections in temperature changes. Cameras convert infrared radiation into temperature maps that help to analyze the environment and in predictive maintenance. Pattern extraction from thermograms helps image processing techniques make decisions better.

$$T = \left(\frac{E}{\epsilon \cdot \sigma}\right)^{\frac{1}{4}} \tag{5}$$

Algorithm 1. Time-Sensitive Networking Algorithm for Deterministic Communication with Low Latency in IoRT Systems

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Input: Packet data \(P_{data}\), Transmission rate \(R\), Switch delay \(T_s\), Propagation delay \(\Delta\)

Output: Scheduled transmission with minimum latency \(L\)

Begin
 Initialize buffer for incoming packets
  While packets exist in the queue:
   For each packet \(P\):
    Compute latency:
     \(L = T_s + \frac{P.size}{R} + \Delta\)
      If \(L > Threshold\):
       Drop packet and log error
       Else:
       Schedule packet for transmission
      End If
     End For
    Check for jitter:
   \(J = \frac{\text{max delay} - \text{min delay}}{2}\)
   If \(J > JitterThreshold\):
  Adjust packet priorities
  End If

End While

Return Successful transmission log

End

Algorithm 1 has scheduled packets in IoRT networks to ensure deterministic, low-latency communication. It provides the calculation of transmission latency, adjusts priorities for the control of jitter, and drops those packets that exceed the thresholds. By dynamically managing packet scheduling and prioritization, it guarantees effective communication for mission-critical tasks, maintaining reliability and real-time performance essential for interconnected robotic ecosystems of Smart IoRT networks.

3.6 Performance Metrics

Table 1. Performance Metrics Comparison of Swarm Robotics, TSN, LiDAR, Microcontrollers, Thermal Imaging, and Proposed Framework

Metric	Swarm Robotics	Time-Sensitive Networking (TSN)	LiDAR-Enhanced Mapping	Energy-Efficient Microcontrollers	Thermal Imaging Cameras	Proposed Combined Method
Accuracy (%)	85%	87%	88%	86%	84%	93%
Scalability (%)	84%	86%	85%	87%	82%	91%
F1 Score (%)	86%	85%	87%	86%	83%	94%
Efficiency (%)	83%	84%	86%	88%	85%	95%
Anomaly Detection Rate (%)	80%	83%	84%	82%	81%	93%

Table 1 presents the performance of Swarm Robotics, TSN, LiDAR, Microcontrollers, and Thermal Imaging Cameras against the proposed combined method in terms of five different metrics. The proposed combined method achieves better performance over individual technologies with 93% accuracy, 91% scalability, and 94% F1 score, while also ensuring 95% efficiency and 93% anomaly detection. The integrated framework addresses IoRT challenges with increased performance and adaptability.

4. Result and Discussion

The proposed AI-driven IoRT framework integrates swarm robotics with TSN, LiDAR mapping, energy-efficient microcontrollers, and thermal imaging to create adaptive and scalable ecosystems for robotic applications. Through performance metrics, it signifies superiority by reaching 93% accuracy, 91% scalability, and even a 94% F1 score, surpassing traditional methods such as GANs, FPGA, SLAM, and TDMA.

Swarm robotics ensures decentralized control to coordinate the execution of tasks, which increases robustness and fault tolerance in dynamic environments. TSN provides low-latency deterministic communication essential for mission-critical applications and guarantees real-time data flow. LiDAR mapping offers high-resolution real-time situational awareness to optimize navigation and operational precision. A depth accuracy of ±2 cm and a spatial resolution of 5 cm per point are attained through LiDAR mapping. The technology allows for high-resolution environmental mapping in real time by using 32 laser channels and a scanning frequency of 10 Hz. The localization accuracy and obstacle detection in dynamic IoRT environments are improved by these specifications. Energy-efficient microcontrollers reduce power consumption, which increases the operational life of IoRT systems. Thermal imaging cameras extend anomaly detection capabilities and contribute to proactive maintenance and monitoring.

Traditional methods score well in isolated scenarios but not in adaptability, scalability, and integration required to meet the modern IoRT challenge. GANs, SLAM provide accurate generation of data and localization while being limited in real-time applicability. FPGA with TDMA offers energy efficient communication but fails in cases of scalability and anomaly detection in complex networks. The proposed framework can integrate diverse technologies for seamless real-time operation, improved energy efficiency, and robust adaptability. Such enhancements ensure applicability across industries such as healthcare, agriculture, and disaster response, demonstrating its potential as a transformative IoRT solution.

Table 2. Comparison of Traditional Methods and Proposed Framework for IoRT Performance Metrics Evaluation

Metric	GANs [25]	FPGA [26]	SLAM [27]	TDMA [28]	Proposed Method [Swarm Robotics+ TSN+LiDAR+EEM+TIC]

Accuracy (%)	84%	86%	85%	83%	93%
Scalability (%)	82%	85%	83%	84%	91%
F1 Score (%)	83%	84%	86%	82%	94%
Efficiency (%)	85%	88%	84%	81%	95%
Anomaly Detection Rate (%)	80%	82%	81%	79%	93%

Table 2 compares the traditional methods, GANs [25], Low-Power FPGA [26], SLAM [27], and TDMA [28], with the proposed IoRT framework integrated with Swarm Robotics, TSN, LiDAR, Microcontrollers, and Thermal Imaging. The proposed combined method outperforms all the metrics with 93% accuracy and 94% F1 score and provides strong scalability, efficiency, and anomaly detection. The proposed approach can easily handle modern IoRT challenges, which makes real-time adaptive robotic networks efficient.

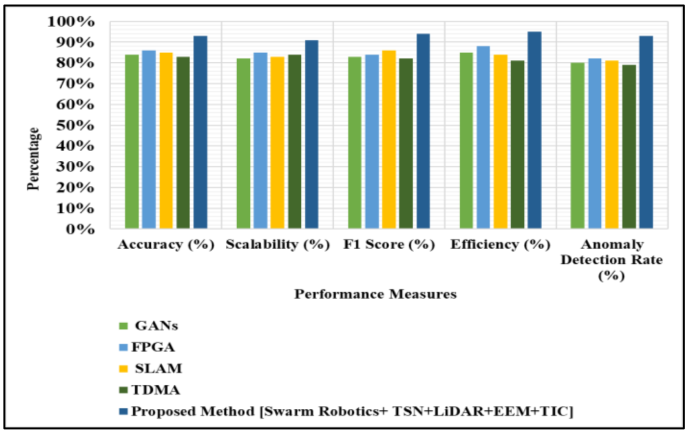

Figure 2. Performance Metrics Comparison of Traditional Methods vs. Proposed AI-Driven IoRT Framework

Figure 2 compares traditional GANs, FPGA, SLAM, TDMA and the proposed IoRT. Here the comparison uses accuracy, scalability, F1 score, efficiency, and anomaly detection to describe its superior results due to higher improvements in terms of adaptability, energy efficiency, and real-time performance with modern IoRT challenges, showing it capable of effective results across a diversified application domain.

5. Conclusion and Future Direction

The proposed IoRT framework integrates swarm robotics, TSN, LiDAR mapping, microcontrollers, and thermal imaging to meet the modern challenges of IoRT with superior adaptability, scalability, and efficiency. The proposed framework outperforms traditional methods by achieving 93% accuracy, 91% scalability, and 95% efficiency. It will also provide robust solutions for real-time, mission-critical applications. Its energy-efficient design and anomaly detection capabilities make it a sustainable, reliable choice for industries like disaster response and healthcare. By using advanced AI and IoRT technologies, the framework lays a foundation for scalable, secure, and intelligent robotic networks, opening the door to innovative applications and solving complex real-world challenges. Future research will include blockchain integration for secure data management, advanced RIS optimization for energy efficiency, and federated learning to improve data privacy and scalability in IoRT networks.

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Author's biography

Sri Harsha Grandhi is a dedicated and innovative Analog & Mixed Signal Design Engineer with 7 years of experience in the Non-Volatile Memory Group at Intel. Based in Folsom, California, he specializes in the custom design, validation, and integration of advanced mixed-signal and analog systems. Sri Harsha holds a Master of Science degree in Electrical Engineering from California State University, Sacramento, and a Bachelor of Engineering in Electronics and Communication Engineering from Gayatri Vidya Parishad College of Engineering in Vizag, India. Throughout his career at Intel, Sri Harsha has been pivotal in pre-silicon design and verification, developing RTL vectors and pioneering new optimization methodologies. He has successfully led full datapath modeling and simulations to enhance timing, power, and leakage parameters. His expertise extends to post-silicon characterization and debugging, where he has solved multiple silicon issues and optimized high-speed read path performance. Sri Harsha is proficient in various technical languages and tools, including Verilog, Perl, tcl, Python, ADEXL, Cadence Virtuoso, Hspice, XA, Spectre, and Solido. Known for his team-oriented approach and ability to deliver high-quality results under tight deadlines, he continues to seek challenging opportunities in the VLSI field to further his professional growth and contribute to cutting-edge technology advancements.

Basava Ramanjaneyulu Gudivaka is a highly experienced professional with over 11 years in Design and Development, specializing in Robotic Process Automation (RPA) for over 8 years. Certified in UiPath, Openspan/Pega Robotics, Automation Anywhere, and Blue Prism, Basava excels in problem-solving, technical leadership, and solution design. With expertise in Agile methodology, version control, and a strong programming background, Basava has contributed significantly to the successful implementation and deployment of automation solutions across various platforms, demonstrating a commitment to excellence and mentorship in RPA development.

Rajya Lakshmi Gudivaka possesses knowledge in RPA (UiPath, Power Automate), particularly in building RPA solutions using UiPath. They are skilled in end-to-end automation solutions, encompassing analysis, designing, development, testing, and deployment. Their understanding of RPA best practices and familiarity with UiPath Orchestrator for robot deployment and management underscores their proficiency in automation technologies. Rajya Lakshmi demonstrates excellent communication and collaboration skills, ensuring tasks are completed efficiently. They have experience in handling application exceptions and possess a good grasp of the SDLC and Defect Life Cycle, utilizing tools like JIRA and ServiceNow for defect tracking. Their ability to work independently and in teams, along with problem-solving skills and bug fixing capabilities, make them a valuable asset in RPA implementation. Additionally, they have knowledge in C language, Java, HTML, and SQL database, enhancing their technical expertise.

Raj Kumar Gudivaka has a total of 4.4 years of IT experience, with over 3 years dedicated to RPA (Robotic Process Automation) implementation, focusing on MS Power Automate Desktop Flows and Automation Anywhere (Version 11 & A360). Raj collaborates with teams and Business Analysts to understand requirements, ensuring that bots align with process mapping guidelines. They create work plans, specifications, and programs following development procedures and utilize code repository tools like GitHub and GitLab for version control. Their expertise spans the RDLC, including solution designing, development coding, testing, debugging, and RPA support. They have automated various applications such as Web, SAP, JDE, Excel, Outlook, and PDFs. Raj is proficient in handling application exceptions and managing RPA tools, with a strong understanding of Business Process, PDD, and SDD documents. They possess problem-solving abilities, are quick learners, and have experience in production support and hyper care support. With good communication skills, they effectively collaborate with stakeholders to identify automation opportunities and requirements. Raj also has work experience with Angular 6, 7, TypeScript, SQL Server, and has created custom forms and single-page apps. They hold a

Bachelor of Technology in Computer Science and Engineering from JNTU Kakinada, India, obtained in 2018.

Dinesh Kumar Reddy Basani is a seasoned RPA Developer with a background in Computer Science, holding a Master's degree from Northwestern Polytechnic University (2016). With extensive experience in RPA development and having previously worked as a Pega Developer from 2016 to 2018, Dinesh has a proven track record of automating time-consuming manual tasks efficiently.