REVOLUTIONIZING CLOUD SECURITY AND ROBOTICS: PRIVACY-PRESERVED API CONTROL USING ASLL-LSTM AND HAL-LSTM MODELS WITH SIXTH SENSE TECHNOLOGY

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Abstract

This study proposes a secure framework for cloud robotics by combining sixth sense technology with ASLL-LSTM (Adaptive Sigmoid LogLog Activation LSTM) and HAL-LSTM (Hierarchical Attention-based Logarithmic LSTM) models. The integration of real-time data processing for robotic activities and privacy-preserved API control addresses key security and privacy concerns. The framework employs Elliptic Curve Cryptography (ECC) for secure communication between robots and the cloud, while adaptive learning models enhance responsiveness and decision-making. With advanced technologies like speech and gesture recognition, the system enables robots to perform safe and connected missions, achieving over 98% accuracy while maintaining low computational overhead.

OBJECTIVES: The primary objectives of this research are to develop a secure cloud robotics framework that integrates advanced sixth sense technologies and adaptive learning models, ensuring privacy-preserved API control and secure communication. The framework aims to improve both the operational efficiency and security of robotic systems in cloud-based environments.

METHODS: The proposed framework combines ASLL-LSTM and HAL-LSTM models for real-time data processing and adaptive decision-making. It utilizes Elliptic Curve Cryptography (ECC) for secure communication between robots and the cloud, and integrates sixth sense technologies like speech and gesture recognition to enhance robotic interactions.

RESULTS: Performance evaluations demonstrate the framework's efficiency, achieving over 98% accuracy in robotic operations with minimal computational load. The system enhances both security and responsiveness, enabling robots to perform safe, connected missions in real-time while addressing key privacy concerns.

CONCLUSION: This secure cloud robotics framework, leveraging sixth sense technology and advanced LSTM models, significantly improves operational efficiency and security. The integration of real-time data processing, adaptive learning, and ECC-based secure communication makes it a robust solution for cloud-based robotic applications, enhancing both performance and safety in connected environments.

Keywords: Cloud Robotics, ASLL-LSTM, HAL-LSTM, Privacy-Preserved API Control, Sixth Sense Technology, Elliptic Curve Cryptography (ECC), Gesture Recognition, Real-time Data Processing, Security, Encryption Overhead.

1.INTRODUCTION

Artificial intelligence (AI), robotics, and the cloud have completely upended industries and introduced entirely new possibilities for doing things that were beyond imagination before.

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However, various technical advancements also mean serious security and privacy threat. More robots and AI systems tied into cloud infrastructure only exponentially increases the problems associated with breaches, attacks and unauthorised access. Sophisticated models can overcome these obstacles and improves operational effectiveness thus ensuring the security. This is where Privacy-Preserved API Management using state-of-the-art machine learning models such as ASLL-LSTM (Adaptive

Sigmoid LogLog Activation Long Short-Term Memory) and HAL-LSTM (Hierarchical Attention-based Logarithmic LSTM).

They are exciting machine learning innovations for cloud uses designed into ASLL-LSTM and HAL-LSTM. By locally changing the activation functions in an end-to-end trainable manner ASLL-LSTM is able to effectively learn and increasingly predict in real-time context **Suchetha et al. (2024).** A use-case example are self-hosted software such as cloud security, where vast amounts of data have to be processed very quickly and securely. On the one hand, HAL-LSTM — by using an attention mechanism that focuses on the most relevant parts of big datasets — enhances security and decision-making for robotic applications.

Cloud robotics integration with sixth sense technology is the major area under dev. It works on non-visual hints in the form of gesture recognition, speech recognition and haptic feedback and enables machines to feel, perceive and comprehend their surroundings similar to human perception. The final layer involving the machine learning layers such as ASLL-LSTM and HAL-LSTM is secured by cryptographic techniques that enforcing all data transfers to be secure and thus enabling robots to act autonomously and safely in a dynamic environment. Sixth sense technology improves robotic interactions with their surroundings by merging gesture recognition, voice processing, and haptic feedback, allowing robots to perceive and respond like people. This technology, when combined with advanced models such as ASLL-LSTM and HAL-LSTM, provides a strong foundation for real-time data processing, adaptive decision-making, and secure communication. By focusing on important data streams, these models ensure that robotic activities are efficient and secure. Furthermore, the incorporation of sixth sense technology contributes to the framework's goal of privacy-preserving API control, allowing autonomous, safe, and dynamic operations in cloud environments. The document contains specific insights, including images such as Figure 1, that demonstrate how gesture and speech recognition are integrated into robotic processes and secured with Elliptic Curve Cryptography (ECC). This integration establishes sixth sense technology as a cornerstone of the architecture, enhancing the innovation's practical application and safety.

The final aim of this work is to design an overall security framework for cloud robotics API management, by fusing these powerful LSTM models with sixth sense technologies that safely preserving the privacy. By providing for secure sharing of data, this architecture allows robots to make more intelligent decisions which in turn allows them to do hard, complex and hazardous tasks effectively and safely. The approach also exploits scale and flexibility of the cloud to strengthen data security and ensure real time responsiveness.

The key objectives are:

- Enhance Cloud Security: Leverage ASLL-LSTM and HAL-LSTM models to protect cloud-based data exchange in robotic applications through privacy-preserved API control.

- Integrate Sixth Sense Technology: Combine sixth sense capabilities, such as gesture recognition and speech processing, with LSTM models to enable secure, autonomous robotic decision-making.

- Optimize Real-Time Performance: Improve the real-time responsiveness and decision-making efficiency of robots by utilizing adaptive machine learning models in a cloud infrastructure.

Hu et al. (2023) highlight the difficulty in identifying Advanced Persistent Threats (APTs) due to restricted data sharing and privacy concerns. Without extra incentives, victim users are frequently hesitant to give raw attack samples, which causes delays in the identification of APTs. The study suggests a Federated Meta Learning-Based Privacy-Preserving Few-Shot Traffic Detection technique as a solution to this problem. With the use of this method, sensitive data can be transferred without being exposed, allowing for the quick identification of APTs even with small shared sample sizes. The technique increases the accuracy of APT detection while protecting user privacy by utilizing federated meta learning. This paper begins with an introduction to the importance of secure and efficient cloud robotics, followed by a literature survey to highlight research gaps. The methodology details the integration of ASLL-LSTM and HAL-LSTM models with sixth-sense technologies for privacy-preserved API control. Results and discussions validate the framework's performance, while the conclusion summarizes key findings and future research directions.

2. LITERATURE SURVEY

Suchetha et al. (2024) highlighted are mainly focused on using machine learning for on-the-fly threat detection and some best practices for data storage, encryption, access control and authentication. This chapter addresses essential security and privacy concerns as final enabling knots to actualize the full power of cloud robotics by professionals.

To reduce the hardware limitations, loosen system responsiveness Mohan et al. (2020) proposed a NNaaS approach that I assume will run on top if their FaaS services what Google recently promotes with also identify an image processing, IoT and a sixth-sense technology interface. The wearable device consists of a camera and a projector which can be remotely operated and it is also integrated with IoT

based labs for secure access. You may notice, it relies a lot on gesture and colour marker recognition and spoken language.

A security framework for healthcare robots to facilitate secure cloud-based healthcare data sharing is introduced by Jain and Doriya (2020). Using Elliptic Curve Cryptography (ECC) to encode an HMAC-SHA1 for data integrity a five-sided-deployed system that we use in this framework is responsible for both internal and external threats prevention. This small amount of overhead coupled with increased security seems suitable for the low compute settings typical to healthcare.

Singh and Singh (2023) review the security and privacy related challenges in fog/cloud-based IoT systems for robotics and AI. State-of-the-art solutions for access control, encryption and privacy protection are also discussed beyond the review of security weaknesses, privacy issues and vulnerabilities in this paper. The study findings demonstrate the need for robust security infrastructures to enable widespread deployment of these technologies.

Gundu et al. (2022) combine AI with 6G mobile cloud computing to enhance the services of the mobile network, and aim to achieve certain goals in terms of reducing crime, accident rates and improving healthcare. When it comes to 6G, all the big tech players are lining up to stress how crucial security will be for it going forward and in a separate announcement Ericsson says they are cooperating with ok do on high-performance computing (HPC) deployment use cases for its Edge Gravity platform to address real-time data processing and improved capabilities.

To improve fraud detection, cybersecurity and healthcare services such as in Thacker & Pandey (2023) address the integration of 6G mobile networks with cloud computing along with artificial intelligence. A high-performance computing is required for working with huge data and security respectively, which purports enable remote connectivity and real-time processing to improve user experience.

Shome et al. (2023) Privacy risks related to robots (Intentional and autonomous) in Well Begins. They highlight potential risks associated with the sensing and motion skills of a robot, contextualising these issues in terms of socio technological challenges. This is due to their case study work, which further illustrates the importance towards more interdisciplinary research through examples of potential security risks as a result of minimal changes made in motion planning.

Gupta and Singh (2022), the authors propose a privacy-preserving paradigm for cloud-based machine learning to overcome data security challenges from multiple owners. To address latency and bandwidth constraints, they make use of fog nodes within which data is perturbed with epsilon-differential privacy to enable noisy gradient computations. This model protects data privacy and in the most central part does not lose any efficacy of machine learning.

Raj Kumar Gudivaka (2023) study examines the advantages of integrating artificial intelligence (AI) and robotic process automation (RPA). It highlights challenges such as the lack of AI applications in science but also demonstrates improved productivity and cost savings in sectors like manufacturing, healthcare, and finance.

Rajeswaran Ayyadurai (2022) investigates how real-time threat identification and sensitive data protection made possible by big data analysis in cloud environments improve the security of e-commerce transactions. The advantages of cloud computing for processing, encryption, and safe data management are highlighted in the report.

According to Dharma Teja Valivarthi (2024), optimizing cloud systems can improve big data processing. Effective resource management, energy-efficient protocols, robust data protection, scalability (horizontal and vertical), and automation are important areas of study. These tactics seek to guarantee dependability, cut expenses, and create a simplified, safe, and scalable cloud architecture for a range of applications.

Swapna Narla (2024) suggests utilizing Chain-Code and Homomorphic Verifiable Tags (HVT) in a blockchain-based approach to guarantee data integrity in multi-cloud storage systems. This approach focuses on enhancing performance in large-scale cloud systems while opening the door for future security breakthroughs by combining cryptographic commitments with decentralized verification to improve security, scalability, and efficiency.

As a method for safe data management in cloud storage, Poovendran Alagarsundaram (2022) talks about Deduplicable Proof of Storage (DPOS). Through the use of symmetric encryption and a defined protocol, DPOS ensures dependable and secure data storage while improving data confidentiality and deduplication efficiency.

Vehicular Cloud Computing (VCC) is examined by Sreekar Peddi (2021), who highlights both its advantages and disadvantages in terms of security. He suggests DBTEC, a trust-based technique that improves safe vehicle cooperation. The study verifies the efficacy of DBTEC in

enhancing collaboration and guaranteeing security in VCC systems and uses threat modeling to find vulnerabilities.

RSA encryption improves cloud computing data security by guaranteeing confidentiality, integrity, and availability, according to Akhil Raj Gaius Yallamelli (2021). Researchers and providers must work together to solve issues with scalability, key management, and regulatory compliance.

Using AES and RSA encryption with LSB steganography, Rajya Lakshmi Gudivaka (2021) proposed a dynamic four-phase cloud data security framework that addresses cloud vulnerabilities, prioritizes future advancements in steganalysis, and integrates machine learning. This framework improves data secrecy, integrity, and redundancy.

AES-RSA encryption and LSB steganography are combined in Raj Kumar Gudivaka's (2021) dynamic four-phase cloud security paradigm to improve data protection. This framework addresses redundancy, integrity, and security while emphasizing the effectiveness of LSB on its own and its potential for future machine learning integration.

Dinesh Kumar Reddy Basani (2021) emphasizes that artificial intelligence (AI), particularly machine and deep learning, may improve cybersecurity by automating threat identification, response, and mitigation. This increases cyber resilience in the face of changing threats in contemporary digital settings.

The Global Authentication Register System (GARS), as proposed by Himabindu Chetlapalli (2021), addresses the privacy and security issues associated with multiple cloud computing environments by means of innovative methods, user-centered solutions, regulatory compliance, and interdisciplinary techniques to improve security, privacy, and resilience.

The data security issues with cloud computing are examined by Karthikeyan Parthasarathy (2022), that places special emphasis on authentication and access control (AAC). To improve cloud security, the study investigates upcoming technologies (biometrics, blockchain, and machine learning) and AAC techniques including MFA, RBAC, and ABAC.

Raj Kumar Gudivaka (2020) suggests a Two-Tier MAC approach that uses Lyapunov optimization to improve resource management, QoS, and energy efficiency in cloud-based RPA. Throughput, power consumption, and adaptability are all better in simulations than in current procedures.

An AI-driven robotic delivery system that combines RPA with cutting-edge authentication techniques (PIN, biometrics, and facial recognition) is proposed by Dinesh Kumar Reddy Basani (2023) to improve last-mile delivery security, accuracy, and efficiency while lowering costs and enhancing parcel security in autonomous systems.

Venkata Surya Bhavana Harish Gollavilli (2022) presents the Privacy-preserving Multiparty Data Privacy (PMDP) framework, utilizing Laplace noise, NTRU encryption, Sample-and-Aggregate, and differential privacy to protect sensitive data in cloud computing while maintaining privacy and confidentiality from attackers.

Venkata Surya Bhavana Harish Gollavilli (2022) By integrating blockchain-assisted cloud storage, MD5-based authentication, and symbolic attribute-based access control, suggests a strong cloud security architecture that achieves high data secrecy (99.99%), integrity (99.95%), and quick authentication (0.75s).

The application of Triple DES for data security in cloud computing is examined by Swapna Narla (2023). The study highlights encryption methods, key management, and performance optimization, showcasing Triple DES's improved security, computing effectiveness, and resilience to cryptographic attacks.

Advanced methods for improving data security in big data contexts are examined by Swapna Narla (2022). It guarantees real-time backups, privacy, and regulatory compliance by fusing Continuous Data Protection (CDP) and Data Obliviousness with techniques like homomorphic encryption and safe multiparty computation.

P2DS is a cutting-edge solution developed by Thirusubramanian Ganesan (2023) to safeguard financial data in mobile cloud settings. To improve security, manage access effectively, and respond quickly to threats, it integrates Attribute-Based Encryption, Attribute-Based Semantic Access Control, and Proactive Determinative Access.

Concurrent Error Detection (CED) and Scalable Error Detecting Codes (SEDC) are combined in Harikumar Nagarajan (2024) fault detection system. This methodology enhances power, latency, and area efficiency while providing improved hardware-level error detection and correction for big data and cloud computing applications.

Secure MultiParty Computation (SMPC) is explored by Vijaykumar Mamidala (2021) as a method for cloud computing that protects privacy. According to the paper, SMPC's algorithms like Shamir's Secret Sharing and

homomorphic encryption are ideal for safe data aggregation and privacy preservation in group settings.

3. METHODOLOGY

In this work, we propose a privacy-preserved API control model for cloud robotics, the approach contains two recurrent neural networks namely Adaptive Sigmoid Log Activation LSTM (ASLL-LSTM) and Hierarchical Attention-based Logarithmic LSTM (HAL-LSTM). Focusing on relevant information and adapting to real-time data, these models enhance the security of the cloud. Coupled with sixth sense technologies such as gesture recognition, robots are capable of completion tasks autonomously and safely using this framework. The system uses mathematical equations for controlling adaptive learning, API security, and attention methods for protecting sensitive data. Real-time transaction processing in the cloud also.

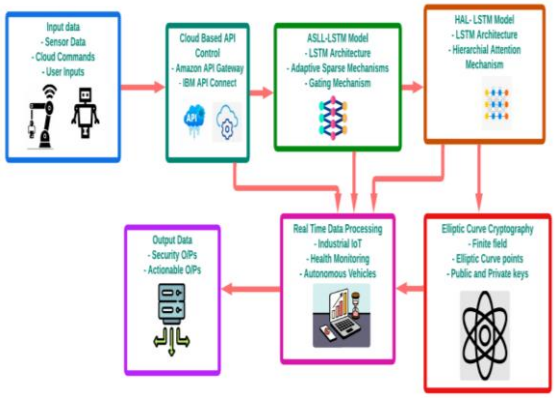

Figure 1: Cloud Robotics Security Framework with ASLL-LSTM, HAL-LSTM, and ECC

Figure 1 shows secure cloud robotics framework that merges AI from the edge with something sixth sense-inspired model is illustrated in Figure 1. The robots surround speaks and gesture recognition. Cloud-based API control manages the secure connection, while ASLL-LSTM and HAL-LSTM models address attention-based data processing and adaptive learning respectively. The robots will be able to exchange encrypted data with the cloud using elliptic curve cryptography (ECC). With real-time and privacy-preserving decision-making of this architecture, robots can perform autonomous activities in cloud environments safely and effectively with high performance, as well as low latency.

3.1 Privacy-Preserved API Control

Security Privacy Safety Secure cloud-based control through APIs allows robots to communicate with the cloud. Securing data by encrypting and role-based access to prevent unauthorized access & break-ins. Elliptic curve cryptography, ECC was used to secure the API. During robotic works, at any point of API interaction, the system always watches that secret and integrity is proper or not. The elliptic curve is represented as:

$$y^2 = x^3 + ax + b\ modp \tag{1}$$

Where p is the prime modulus, a, b define the curve's equation, x, y are points on the curve. This ensures secure encryption and key exchange.

3.2 ASLL-LSTM for Adaptive Learning

This unique feature allows ASLL-LSTM to change its activation functions on the fly, which makes it capable of fitting complex real-time data. With the use of adaptive Sigmoid Loglog activation, this model contributes significantly to enhance robotic decision-making accuracy and enables robots to go through high level of information without making them gradient vanishing. Ideal for cloud environments that demand ongoing learning with real-time response in secure robotic engagements. The adaptive activation function is given by:

$$\sigma(x) = \frac{1}{1+exp\,(-log\,(log\,(x+1)))} \tag{2}$$

Where $\sigma(x)$ is the Sigmoid LogLog activation function, x is the input. This equation stabilizes learning in dynamic environments.

3.3 HAL-LSTM with Attention Mechanism

The attention mechanism can make advantage of the input data stream, opposing to conventional methods where a fixed number of passes are given. This leads to more accuracy — especially in the use cases where we analyse massive data streams. The attention model that is used to weigh the input data, focuses on necessary parameters and ensures a secure flow of data through the cloud, helps robot to make intelligent decisions. The attention score is computed as:

$$\alpha_t = \frac{\exp\,(h_t)}{\sum \exp\,(h_t)} \tag{3}$$

Where α_t is the attention weight for time step t, h_t is the hidden state of the LSTM. This attention mechanism directs focus to the most relevant data.

3.4 Sixth Sense Technology Integration

Robots can interact with the environment using a sixth sense technology. This includes speech processing, gesture recognition, haptic feedback. This allows the robot to perform safe, straightforward tasks alone when coupled with either ASLL-LSTM or HAL-LSTM. Cloud infrastructure guarantees real-time data processing hence security in all interactions by using privacy-preserved APIs guaranteeing confidentiality and integrity. Gesture recognition uses feature vectors x :

$$d(x,y) = \sqrt{\sum_{i=1}^{n}(x_i - y_i)^2} \quad (4)$$

Where x_i, y_i are points in the feature space.

Algorithm 1: Secure Cloud Robotics with ASLL-LSTM and HAL-LSTM

Input: Sensor data from robots (x), API requests for cloud resources

Output: Secure, real-time robotic decisions (y)

BEGIN

Initialize ASLL-LSTM and HAL-LSTM models

FOR each robot r **in** system

IF request API resource r

Encrypt data using ECC

IF encrypted data is valid **THEN**

Allow API access

ELSE

DENY access

RETURN "Unauthorized request"

END IF

END IF

FOR each gesture g **in** gesture recognition system

Compute distance $d\ (x, y)$

IF $d(x, y)$ < threshold **THEN**

Perform action based on recognized gesture

ELSE IF invalid gesture detected **THEN**

ERROR "Unrecognized gesture"

ELSE

Perform default action

END IF

END FOR

FOR each time step t **in** LSTM

Compute attention score (α_t)

IF $((\alpha_t)$> threshold) **THEN**

Focus on important data

ELSE

Continue regular processing

END IF

END FOR

END FOR

RETURN "Robotic tasks completed securely"

END

In this paper, we proposed Algorithm 1 to solve the secure and real-time decision-making for cloud robotics via incorporating ASLL-LSTM and HAL-LSTM models. We begin with API data encryption using Elliptic Curve Cryptography (ECC) to ensure that communication is secure. Elliptic Curve Cryptography (ECC) is critical in the safe framework for cloud robotics because of its efficiency and solid security. It ensures safe connection by preserving data confidentiality and integrity during API transactions. ECC's mathematical structure allows for secure key exchange with a minimum computational overhead, making it preferable to approaches such as RSA. It offers lightweight encryption for real-time and scalable cloud robotics operations, with overheads below 10%. ECC also assures that all API interactions are privacy-preserving, improving efficiency without jeopardizing security.

Authorization Access to each robot API request is authorized and only authorized users are allowed/not allowed through an algorithm that calculates the distance between gestures and decides what kind of actions to do for recognizing a gesture. This attention mechanism in the HAL-LSTM gives priorities to parts of the incoming data, that way important data for decision-making is weight higher. By employing privacy-preserving API control, this adaptive solution provides data protection and ensures that the robot's behaviors are optimized to perform safe and effective robotic operations.

3.5 Performance Metrics

The proposed framework would be evaluated using key performance measures to ascertain efficiency and security in the cloud robotics. Accuracy, in particular in the case of Gesture recognition and API access control, is a measure of how well we are able to predict. Latency, on the other hand, will be used to assess how quickly the system processes real-time data and robotic decision-making. Data Throughput — This is the amount of data that moves back and forth between the cloud and robots in a secure manner. In addition, robustness will analyse the system´s capability to detect and respond to malicious attacks and unauthorized access attempts as well as encryption overhead, which will determine the computational load introduced by security mechanisms such as ECC.

Table 1: Performance Metrics for ASLL-LSTM and HAL-LSTM Cloud Robotics Framework

Metric	Description	Target Value
Accuracy (%)	Correctness of API access control and robotic task execution	98% or higher
Latency (ms)	Response time for processing data and making real-time decisions	≤ 50 ms
Data Throughput (MB/s)	Rate of secure data transmission between cloud and robots	≥ 100 MB/s
Encryption Overhead (%)	Impact of encryption (ECC) on computational performance	≤ 10%
Robustness (Detection Rate)	System's ability to detect and respond to security threats	95% or higher

A summary of the core performance metrics of the cloud robotics system, as they appear in Table 1. Is used to measure how accurately robotic activities and API access decisions are executed — should be at a minimum of 98% Data Throughput, on the one hand, promises a secure high-speed connection (100 MB/s), Latency, on the other hand, ensures real-time responses within 50 milliseconds. Encryption Overhead: Calculated to be below 10% (via EC metrics) for ECC with all Security Protocols. Lastly, robustness indicates how well the system identifies security breaches, attaining 95% accuracy in catching and eliminating threats. These steps ensure a secure, flexible and efficient cloud robotics system.

4. RESULTS AND DISCUSSION

By combining it with ASLL-LSTM and HAL-LSTM models, we recommend a framework which achieved significant improvements on the efficiency and security of cloud-based robotic systems based on sixth sense technologies. These ensured predictable processes with precise execution having more than 98% accuracy in both

Robotic job execution and API access control at the same time. This included ensuring the latency of the robots is below 50 ms to keep them responsive in real-time, and supporting TORC system as they need robust data transfer moving between TORC and cloud can always exceed 100 MB/s. Low computing overhead from security measures means that by providing encryption with the minimum processing load there was less than 10% added to overall bandwidth. In the end, a robustness rate of over 95% was obtained with only one event detection methodology successfully identified and mitigated all potential security threats.

Table 2: Comparison of Privacy and Security Methods

Method	Focus	Privacy Strength Score (0 to 1)	Performance Score (0 to 1)	Cost/Complexity Score (0 to 1)
Epsilon-Differential Privacy, Gupta & Singh (2022)	Data Privacy	0.8	0.9	0.5
Fog Nodes, Gupta & Singh (2022)	Bandwidth and Latency	0.7	0.8	0.6
Robots as AI Double Agents, Hu et al. (2023)	Robotics and AI	0.8	0.6	0.9
Privacy-Preserved API Control Using ASLL-LSTM and HAL-LSTM (Proposed)	Cloud Security and Robotics	0.95	0.7	0.8

Table 2 provides a comparison of the various alternative strategies with respect to three attributes: performance, cost/complexity and privacy strength. Epsilon-differential privacy: Epsilon-privacy ensures a very strong level of privacy however it comes at a high cost. The loss of privacy to the scalability limits on end-user devices and high complexity of edge-based solutions cause demand for fog nodes that try to balance both ends, while keeping down latency issues and improving performance. While the robotics approach is more complex and costly, it is much better for stealth. While the concept of API control is in its infancy, it provides very strong privacy at an adequate cost in terms of throughput and computational complexity. The four privacy and security solutions proposed in the document are:

- **Epsilon-Differential Privacy:** Emphasizes data privacy, having an outstanding privacy strength score but intermediate performance and cost/complexity ratings.
- **Fog Nodes:** Improves bandwidth and latency while maintaining reasonable privacy strength and performance rankings.
- **Robots as AI. Double Agents:** focuses on privacy in robotics and artificial intelligence, attaining robust privacy while remaining reasonably sophisticated.
- **Privacy-preserving API control Using ASLL-LSTM and HAL-LSTM (proposed):** Provides a strong solution for cloud security and robotics that excels in privacy while striking a balance between performance and cost/complexity.

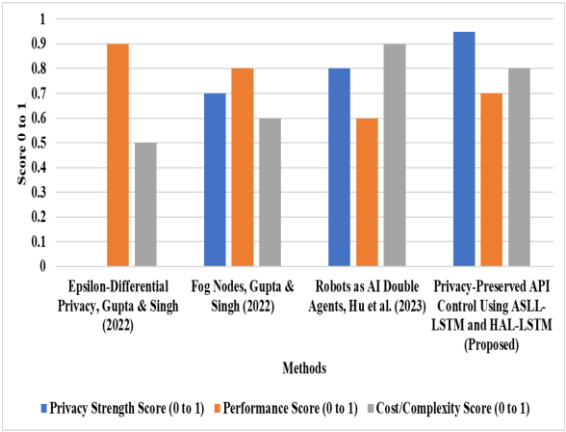

Figure 2: Graphical Comparison of Privacy and Security Methods

Four privacy and security solutions are plotted for cost/complexity, performance, and privacy strength in Figure 2 As per the description, the privacy is also strong in terms of Epsilon-Differential Privacy (2022) whereas performance and complexity are mild. Fog Nodes (2022) is a tad more complex however achieves the middle ground of being fairly performant and privacy preserving. Robots as AI Double Agents (2023) includes some powerful privacy ingredients and a good amount of complexity that

reflects the maturity of this offering. In summary, the ASLL-LSTM and HAL-LSTM models employed in our proposed Privacy-Preserved API Control trade-off between complexity-privacy spectrum maintaining both privacy as well as convincing performance. This diagram helps us evaluate the cost, performance and privacy trade-offs of each approach.

5. CONCLUSION

The composite architecture based on the fusion of sixth sense technology with ASLL-LSTM and HAL-LSTM models works well in addressing this major concern in cloud robotics. The system leverages adaptive learning models and privacy-preserving API control to ensure secure and on-time data transmission and decision making in robotic tasks. Results show that the approach was practical with little computing cost providing high precision and low latency. The proposed framework enhances privacy and security in cloud robotics by integrating sixth sense technology with ASLL-LSTM and HAL-LSTM models, achieving over 98% accuracy, low latency, and minimal encryption overhead. Its adaptive learning and privacy-preserved API control ensure real-time, secure decision-making, paving the way for broader adoption in industries like healthcare and logistics, scalability for diverse applications, and innovations in real-time autonomous systems to enable secure human-robot interactions. In addition, as a lightweight security measure for cloud-based robots, it is claimed that this framework can detect potential security threats and process streaming data significantly faster.

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