

# SANDEEP KALARI

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## EDUCATION

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- **Old Dominion University** *Norfolk, VA*
  - *Ph.D. in Computer Science (All But Dissertation Status) Expected Dec 2026*
    - *Dissertation Research:* Trustworthy AI using Large Language Models. My work focuses on enhancing the reliability, privacy, and explainability of generative AI systems by integrating techniques from multimodal learning, blockchain, and advanced prompting, finetuning strategies.
- **Master of Science in Computer Science** *Dec 2023*
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- **CBIT, Osmania University** *Hyderabad, India*
  - *Master of Computer Applications (MCA)* *Aug 2021*

## RESEARCH INTERESTS

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- Trustworthy Explainable AI (XAI)
- Multimodal Large Language Models (Vision-Language)
- Generative AI Retrieval-Augmented Generation (RAG)
- AI for Finance and Aviation Safety
- Blockchain and AI Integration

## PUBLICATIONS

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1. **ReViewQwen: An Explainable Vision-Language Model for Discrepancy Detection in Multimodal E-Commerce Reviews**  
**Sandeep Kalari**, Mohan Krishna Sunkara, Dominik Soos, Vikas Ashok, Ravi Mukkamala  
*Proceedings of the 2025 IEEE International Conference on Content-Based Multimedia Indexing (CBMI)*, Dublin, Ireland.
2. **BlockQwen: A Robust LLM Powered by Blockchain and Smart Contracts**  
**Sandeep Kalari**, Ravi Mukkamala, Vikas Ashok, Stephan Olariu, Eranga Bandara, Sachin Shetty  
*Proceedings of the 7th International Conference on Blockchain Computing and Applications (BCCA 2025)*, Dubrovnik, Croatia.
3. **MerkleChain: A Privacy-enhanced and Flexible Merkle-tree-based Blockchain Architecture**  
Ravi Mukkamala, Stephan Olariu, and **Sandeep Kalari**  
*Proceedings of the 7th International Conference on Blockchain Computing and Applications (BCCA 2025)*, Dubrovnik, Croatia.
4. **AeroQwen: Case Study on Aircraft Maintenance Using a Multimodal Vision-Language Framework**  
**Sandeep Kalari**, Abhinav Panchumarthi, Vikas Ashok, Ravi Mukkamala  
*Proceedings of the 2026 IEEE Aerospace Conference*, Montana, USA. (Abstract Accepted)
5. **Employing AI/ML/DL/RL/LLM Tools to Advance Aviation Maintenance Processes for Improved Safety and Reduced Costs: A Survey**  
**Sandeep Kalari**, Gowri Lenkala, Vikas Ashok, Ravi Mukkamala

## RESEARCH EXPERIENCE

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- **Old Dominion University** *Norfolk, VA*
- *Graduate Research Assistant 2023 – Present*

My research is centered on building **Trustworthy AI systems** by tackling core challenges in reliability, security, and explainability, with a specific focus on Multimodal Large Language Models.

  - **Multimodal E-Commerce Discrepancy Detection (ReViewQwen):**
    - \* **Problem:** E-commerce platforms suffer from a trust deficit where seller claims (via images and text) often misalign with the actual product received by buyers. Traditional unimodal analysis fails to capture these complex, cross-modal inconsistencies.
    - \* **My Contribution:** I led the development of **ReViewQwen**, a novel vision-language framework designed to act as an impartial adjudicator. The system jointly analyzes seller-provided images and descriptions alongside buyer-submitted photos and reviews. I engineered a specialized fine-tuning and prompting strategy for the Qwen2-V model, enabling it to reason about the alignment between claims and reality.
    - \* **Outcome:** The framework achieved an **88% accuracy** in discrepancy detection, substantially outperforming baselines like LLaMA 3.2 and Phi-3.5. This research provides a robust solution for enhancing transparency and fairness on e-commerce platforms.
  - **Blockchain-Augmented LLMs for Trust (BlockQwen & MerkleChain):**
    - \* **Problem:** Deploying LLMs in high-stakes domains like healthcare is fraught with risk, including data privacy breaches, reliance on unverified information sources (leading to hallucinations), and a lack of auditable decision-making trails.
    - \* **My Contribution:** I designed and prototyped **BlockQwen**, a framework that hardens an LLM's operational pipeline with blockchain technology. I developed a system that uses smart contracts to enforce cryptographic data provenance, granular role-based access control (RBAC), and immutable audit logs. I also co-authored **MerkleChain**, which proposes a more flexible blockchain architecture. I developed the entire working prototype for the BlockQwen system.
    - \* **Outcome:** In simulated healthcare scenarios, BlockQwen achieved an **86.25% privacy preservation rate** and an **88.33% hallucination mitigation rate**. This work establishes a new paradigm for building verifiably secure and regulation-compliant LLM systems.
  - **Multimodal AI for Aviation Maintenance (AeroQwen & Aviation Survey):**
    - \* **Problem:** Aircraft maintenance is a safety-critical process that relies on the manual integration of disparate data sources: visual inspections, high-frequency sensor telemetry, complex audio and complex technical manuals. This fragmentation increases the risk of human error and costly operational delays.
    - \* **My Contribution:** I developed **AeroQwen**, a proof-of-concept multimodal diagnostic assistant. The system uses a Multimedia-Language Model to jointly reason over synchronized video frames, audio in the video and sensor data streams. I implemented a **Chain-of-Thought (CoT) prompting strategy** that guides the model to perform a step-by-step analysis, mimicking the diagnostic process of a human expert.
    - \* **Outcome:** AeroQwen achieved **86.44% classification accuracy** in assessing component health and was able to generate clear, actionable maintenance reports. This research demonstrates the feasibility of creating AI co-pilots for technicians, enhancing both the safety and efficiency of aviation MRO.

## PROFESSIONAL EXPERIENCE

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- **TechAbstractor LLC** *Arlington, TX*
- *AI Solutions Engineer Intern May 2025 – July 2025*

I was entrusted with the sole responsibility of conceptualizing, architecting, and deploying a full-stack, end-to-end AI product from scratch, bridging my academic research with the practical challenges of building a scalable, real-world application.

– **Product Vision: The Virtual AI CFO**

- \* I developed an innovative AI-powered chatbot designed to function as a "Virtual AI Chief Financial Officer" for accounting firms, automating the laborious tasks of financial document analysis, categorization, and insight generation.

– **Technical Leadership and Implementation:**

- \* **Cloud Architecture:** Designed and implemented the entire cloud infrastructure on **Amazon Web Services (AWS)**, utilizing **EC2, S3, OpenSearch**, and an Elastic **Load Balancer**.
- \* **AI Core (RAG Pipeline):** Engineered a sophisticated **Retrieval-Augmented Generation (RAG)** pipeline to ingest and process financial documents, feeding relevant context to a **Claude LLM** hosted on **AWS Bedrock**.
- \* **Full-Stack Development:** Built the complete application stack, developing a responsive front-end with **React** and a secure back-end with **Node.js**.

• **Infinity Hydroponic Green Farms**      *Hyderabad, India*

*ML Engineering Intern*      *Aug 2021 – Dec 2021*

This role focused on applying IoT and lightweight machine learning models to develop a proof-of-concept for automated precision agriculture, bridging the gap between hardware and intelligent software.

– **End-to-End IoT Prototyping & Edge AI:**

- \* I designed and built a complete IoT automation prototype from the ground up, using a **Raspberry Pi** to collect and process data from a network of environmental sensors (e.g., humidity, temperature, nutrient levels).
- \* I demonstrated my skills in **Edge AI** by integrating and deploying lightweight ML models directly onto the device. This included a **YOLO** model for real-time visual inspection of plant health and a **BERT**-based model for analyzing textual sensor logs to identify anomalies.

– **Computer Vision for Predictive Health Monitoring:**

- \* I developed and trained a computer vision system that analyzed images of water quality and weather patterns to detect early signs of plant distress, such as disease or nutrient deficiency, achieving a high **95% accuracy**.
- \* This system successfully shifted the farm's operational model from reactive to predictive, enabling proactive interventions and preventing crop damage.

– **Autonomous Alerting System & Impact:**

- \* I engineered a fully autonomous notification system that completely **eliminated the need for 100% of manual monitoring** of key growth parameters.
- \* I deployed a robust, cross-platform alert mechanism that delivered real-time updates to any device, **reducing the response time to critical events by 80%** and preventing potential crop loss.

## TECHNICAL SKILLS

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- **Programming Databases:** Python, Java, R, JavaScript, HTML/CSS, SQL, NoSQL, MongoDB
- **AI/ML/DL Libraries:** PyTorch, TensorFlow, Keras, Scikit-learn, Pandas, NumPy, OpenCV, LangChain, Hugging Face
- **AI Concepts:** Large Language Models (LLMs), Vision-Language Models (VLMs), Retrieval-Augmented Generation (RAG), Prompt Engineering, Reinforcement Learning, Explainable AI (XAI), Trustworthy AI
- **Cloud MLOps:** AWS (Bedrock, EC2, S3, OpenSearch, QuickSight, Load Balancer), Docker, Git
- **Big Data:** Apache Spark, Hadoop, Kafka