TAPON KUMER RAY

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RESEARCH INTERESTS

Multimodal AI Systems · Algorithms · Intelligent Adaptive Agents · LLM Alignment · Computer Vision

EDUCATION

Bachelor of Technology — Computer Science and Engineering
VIT-AP University (Vellore Institute of Technology), Amaravati, India
GPA: 7.5 / 10.0

Relevant coursework: Design Analysis and Algorithm, Data Structures and Algorithm, Linear algebra, Object Oriented Programming, Human-Computer Interaction, Machine/ Deep Learning, Computer Vision, Natural Language Processing

PUBLICATIONS

Refereed Conference Papers

1. **Ray, T.K.,** Yesuraj, R., Rajkumar, Y., Shalini, R., Srigayathri, K., Jayashree, S. *"XMACNet: An Explainable Lightweight Attention-Based CNN with Multi-Modal Fusion for Chili Disease Classification."* Springer LNICST (International Conference on Advanced Computing and Communication Systems), 2025. **[Published]**
2. **Ray, T.K.,** Yesuraj, R. *"Synchronous Emotional Dynamics in Human-AI Collaborative Networks: A Temporal Graph Neural Network Approach."* IEEE International Conference on Computing, Communication and Networking Technologies (CICN), 2025. **[Published]**

Papers Under Review (Q1 Journals)

3. **Ray, T.K.,** Yesuraj, R. *"A Comprehensive Survey on Human Behavior Prediction by Speech, Emotion and Gesture using Deep Learning Approaches."* Journal of Ambient Intelligence and Humanized Computing [Q1], Springer, 2025. **[Under Review]**
4. Yesuraj, R., **Ray, T.K.** *"Segment-Based Dynamic Programming for Optimal Binary Search Trees: A Sub-Cubic Algorithm with Hierarchical Weight Partitioning."* Algorithmica, Springer, 2025. **[Under Review]**
5. **Ray, T.K.,** Yesuraj, R. *"Context-Aware Emotionally Adaptive Voice Assistants: A Multi-Modal Framework for Empathetic Human-Agent Interaction."* Journal of Automation and Intelligence [Q1], Elsevier, 2025. **[Under Review]**

Abstracts & Presentations

6. Yesuraj, R., **Ray, T.K.** *"Segment-Based Dynamic Programming for Optimal Binary Search Trees: A Sub-Cubic Algorithm with Hierarchical Weight Partitioning."* National Conference on Undergraduate Research (NCUR), Abstract ID: 27596, Richmond, USA, 2026. **[Presented]**

RESEARCH EXPERIENCE

Research Fellow— Plaksha University *July 2026 – Present*
Advisor: Dr. Sunita Chauhan, Plaksha University, India

- Building an **LLM-powered multi-agent healthcare-assistance** system on the temi robotic platform for supervised patient interaction, telepresence, reminders, and staff-request routing.
- Designing an **image–text fusion pipeline** to extract visual findings from ultrasound scans and generate structured, clinically interpretable reports.

Undergraduate Research Assistant — AIR Center, VIT-AP University *May 2024 – December 2025*
Advisor: Dr. Rajkumar Yesuraj | Amaravati, Andhra Pradesh, India

- Designed and developed **EmpathicVA-LLM**, a multimodal affect-aware voice assistant integrating Whisper-large-v3, WavLM, emotion2vec+, and a Llama-3-8B backbone with RLHF and DPO alignment. — targeting India HCI.

- Proposed **ETHICS-UI**: a human-centered framework for interactive ethical constraint specification for LLM decision support, featuring a custom Constraint Specification Language (CSL) and a Verification Engine — targeting ACM CHI.
- Developed **TARN** (Temporal Affective Resonance Network), a temporal graph neural network framework modeling synchronous emotional dynamics in human-AI collaborative networks — presented at IEEE CICN 2025.
- Executed **data pipelines and statistical analyses** using Python, SPSS, and SciPy across multiple experiments; maintained reproducible research codebase on GitHub.

Project Associate — IIEC Center, VIT-AP University *August 2023 – July 2024*

Advisor: Dr. Guruprakash Jayabalasamy | Amaravati, Andhra Pradesh, India

- Conducted a systematic literature review on vision-language interaction models in HCI; contributed to experiment design for evaluating multimodal adaptive systems in AR-supported human-robot collaboration settings.
- Investigated adaptive UI models in AR environments; co-authored project reports on **collaborative agent**-interface interaction paradigms.

Project Intern — DUBSYNC.AI *March 2023 – June 2023*

Hyderabad, Telangana, India

- Contributed to speech synthesis pipeline development in an early-stage AI dubbing startup; gained industry exposure to audio ML systems.

CONFERENCE ACTIVITY & PROFESSIONAL SERVICE

Paper Presenter — International seminar on "Digital Dreamscapes: Youth Navigating AI, Creativity & Virtual Expression" *Mar 2026*

VIT Vellore, India — Organized by the Office of International Relations in collaboration with the Department of Youth Affairs, Ministry of Youth Affairs & Sports, Govt. of India.

Student Volunteer (SV) — POPL 2026 (The 53rd ACM SIGPLAN Symposium) *Jan 2026*

Rennes, France — Principles of Programming Languages

Student Mentor — Junior Researcher Mentoring, AIR Center VIT-AP *Sep 25 – May 2026*

Guided undergraduate sophomore/ junior students in research methodology, policy, tools, literature review, and paper writing/ publishing in HCI and AI domains.

Harvard Aspire Leaders Program — Aspire Institute *May – Aug 2023*

Cambridge, Massachusetts, USA — Selected competitive leadership cohort; engaged with Harvard faculty on global research and leadership.

Member — Rotaract Club of VIT-AP University *Mar 23 – Jul 2025*

Community outreach: food donation drives, health camps, environmental clean-ups, educational support for underprivileged children.

AWARDS, HONORS & FELLOWSHIPS

- **ACM India Fellowship** — *2026 ACM SIGMOD/PODS Conference, Bengaluru, India* 2026
- **ACM SIGPLAN PAC Award** — *POPL 2026 — The 53rd ACM SIGPLAN Symposium, Rennes, France* 2025
- **Selected: Student Mentoring Workshop (SMeW)** — *ICSE Conference 2026, Rio de Janeiro, Brazil* 2025
- **Finalist — MARK-XXIV National Hackathon** — *Woxsen University, India* 2023
- **Merit-Based Academic Excellence Scholarship** — *I-SEE (International Scholarship for Education & Enrichment), Vellore Institute of Technology(VIT-AP University), India* 2022

RESEARCH PROJECTS

ETHOS-ALIGN — Ethical Trajectory Optimization for Human-AI Systems *2026*

*SDP- Senior Design Project**, BTech Thesis Project** — Advisor: Dr. Sunkara Kalyani*

- Developed A full-stack implementation of ETHICS-UI: Compiles domain-specific ethical constraints (CSL) into temporal logic formulas (LTL/CTL), runs a model-checking verifier against LLM decision traces at inference time, and exposes an interactive HCI interface for specifying, stress-testing, and auditing constraints in high-stakes domains (medical triage, legal advice, autonomous systems).

Context-Aware Decision Making Agent for Smart Assistants *2025*

***Capstone** BTech Project — Advisor: Dr. Rajkumar Yesuraj*

- Developed an on-device multimodal(speech, text, gesture, EEG) signal fusion system (voice + wearable biometrics) with RL-based adaptive decision policies; privacy-preserving architecture achieving real-time inference.
- Technical stack: Python, PyTorch, LLaMA-3, Whisper, ROS, Combinely 3 large scale dataset with live signal data.

XMACNet — Agricultural Disease Classification *2025*

- Led model design for explainable, lightweight attention-based CNN with multi-modal fusion for chili disease classification; published at Springer LNICST 2025.

Machine Vision Based Third Eye — Safe Driving System *2023*

B.Tech Engineering Clinics Project — Advisor: Dr. Shalini Ramanathan

- Developed a non-invasive eye-tracking interaction model using WebGazer.js and OpenCV for navigation assistance in constrained environments.

TECHNICAL SKILLS

Programming Languages: Python, Java, R, HTML, MATLAB, SQL
Deep Learning Frameworks: PyTorch, TensorFlow, Keras, Scikit-learn, Hugging Face Transformers
Multimodal / Speech AI: Whisper-large-v3, WavLM, emotion2vec+, LLaMA-3-8B, RAG, RLHF, DPO alignment
Data Analysis & Visualization: NumPy, Pandas, SciPy, SPSS, RStudio, Matplotlib, Seaborn, Tableau
Design & Prototyping: Figma, Adobe XD
Research Tools: LaTeX, Overleaf, Mendeley, Zotero, Jupyter Notebook, Git

Languages (Human): English, Hindi, Bengali, Spanish (professional working).

CERTIFICATIONS

- **Multimodal Machine Learning** — Carnegie Mellon University
- **CS224N: Natural Language Processing with Deep Learning** — Stanford University
- **Scientific Machine Learning** — Purdue University
- **Deep Learning in Scientific Computing** — ETH Zürich
- **AI in the Sciences and Engineering** — ETH Zürich

REFERENCES

Dr. Sunita Chauhan

PhD, DIC (Medical Robotics), Imperial college, London, UK

Dean of Research, Plaksha University
[sunita.chauhan@plaksha.edu.in]

Dr. Rajkumar Yesuraj
Assistant Professor
School of Computer Science and Engineering, VKarunya Institute of Technology and Sciences (Deemed University)
[yrajkumar@karunya.edu]

Dr. Lidiany Cerqueira
Senior Software Engineer (Mentor)
Universidade Federal de Sergipe, Sergipe, Brazil
[available upon request]

Mr. Apoorv Ingle
PhD student (Mentor)
Department of Computer Science, University of Iowa, Iowa, USA
[available upon request]

**Additional references available upon request.*