Shivendra Agrawal

Curriculum Vitae

Boulder, Colorado
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Research Interests: Human-Robot Interaction (HRI), Embodied AI, Assistive Technology, Semantic Perception.
Summary: Ph.D. Candidate in Computer Science developing *context-aware human-centered AI* for real-world robotics. My research bridges *Robotics, HRI, and Embodied AI* to create systems that interpret *semantic, social, and geometric cues* to support visually impaired individuals in unstructured environments. Technical expertise spans *computer vision deployment*, *full-stack system architecture*, and *human-subject evaluation*, leveraging modern techniques from *probabilistic planning* to *Foundation Models (VLMs)* for deployable embodied AI. Proven track record of publishing in top-tier venues (HRI, AAMAS, IROS).

Education

2019– **University of Colorado, Boulder**, *Ph.D. Candidate*, *Computer Science*.

2017–2019 **University of Colorado, Boulder**, *MS*, Computer Science.

2009–2014 **Indian Institute of Technology, Kharagpur**, *Integrated BS + MS*, *Mathematics & Computing*.

Publications

Under Review

2025 **S. Agrawal**, A. Naik, J. Brawer, B. Hayes. "ShelfAware: Real-Time Visual-Inertial Semantic Localization in Quasi-Static Environments with Low-Cost Sensors." (2025). (Website)

Refereed Conference Papers

AAMAS 2023 **S. Agrawal**, S. Nayak, A. Naik, B. Hayes. "ShelfHelp: Empowering Humans to Perform Vision-Independent Manipulation Tasks with a Socially Assistive Robotic Cane." (Website)

IROS 2022 **S. Agrawal**, M. E. West, B. Hayes. "A novel perceptive robotic cane with haptic navigation for enabling vision-independent participation in the social dynamics of seat choice." (Website)

HRI 2019 **Best Paper Runner-up:** A. Tabrez, **S. Agrawal**, B. Hayes. "Explanation-based reward coaching to improve human performance via reinforcement learning." (Website)

Research Experience

2019–Present **Graduate Research Assistant**, *Collaborative AI and Robotics (CAIRO) Lab*, University of Colorado Boulder.

- **Generative Interaction (ShelfExplain) – Current Work:** Leveraging Vision-Language Models (VLMs) to generate multi-granularity scene descriptions (store layout vs. product arrangement) and human-like natural language navigation instructions (e.g., "Turn right at the cereal") for situational decision support.
- **Semantic Localization (ShelfAware):** (Ongoing) Designed a **Semantic Particle Filter** that utilizes quasi-static object-level landmarks as mathematical distributions for robust localization in "kidnapped robot" scenarios. Integrated RGB-D and Visual-Inertial Odometry (VIO) to achieve state-of-the-art accuracy on low-cost hardware.
- **Assistive Manipulation (ShelfHelp):** Created a robotic cane system for fine-grained manipulation guidance. Implemented a Markov Decision Process (MDP) planner learned from human demonstrations to optimize verbal instruction timing.
- **Social Navigation:** Developed a goal-finding framework modeling privacy and intimacy norms and integrated it with path-planning and haptics-based guidance. Conducted human-subject studies validating increased confidence in reaching the goal.
- **Explainable Robotic Coaching:** Developed a second-order "Theory of Mind" framework allowing robots to infer human mental models and provide targeted, explainable coaching by observing suboptimal actions (Best Paper Runner-up, HRI '19).

Industry Experience

Sep 2016 – May 2017 **Associate Data Scientist**, Noodle.ai.

- **Automated Analytics:** Engineered automated pipelines for **Exploratory Data Analysis (EDA)** to evaluate large-scale datasets, reducing manual analysis time by 40%.
- **Predictive Modeling:** Designed and deployed predictive models for demand forecasting and churn analysis for major enterprise clients.

Mar 2016 – Aug 2016 **Co-Founder**, Progyrus.

- **System Architecture:** Architected a distributed task management system for large-scale vernacular translation, managing work allocation for 50+ concurrent translators.
- **Full-Stack Development:** Designed RESTful APIs (Django) and the frontend interface (AngularJS) for the order management platform.

2014 – 2016 **Senior Engineer (Analytics)**, Robert Bosch GmbH.

- **Optimization Algorithms:** Developed a clique-based algorithm to optimize vehicle prototype configurations, satisfying complex boolean constraints to reduce physical testing costs.
- **NLP Tooling:** Engineered a Python-based GUI (Tkinter) for automated log analysis and ticket clustering, utilizing NLP techniques to identify recurring vehicle faults.

Teaching Experience

Instructor CSCI 3104 Algorithms - *Best Part Time Graduate Instructor* (2019-2020).

TA CSCI 3104 Algorithms - *Outstanding TA award* (2018, 2019).

CSCI 3002 Fundamentals of Human Computer Interaction.

CSCI 3302 Intro to Robotics - *Outstanding TA award* (2022).

CSCI 4302/5302 Advanced Robotics (2023).

CSCI 5322 Algorithmic Human-Robot Interaction (2025).

CSCI 3202 Intro to AI (2026).

Other Projects

2024 **Autonomous Anomaly Explanation (NEC Corporation)**, *University of Colorado Boulder*.
Developed a proof-of-concept system that uses a Vision Language Model (VLM) and a mobile robot to autonomously explain spatial anomalies. (Video Demo)

2019 **Robot Guide Dog for Visually Impaired**, *University of Colorado Boulder*.
Emulated a guide dog behavior in indoor scenarios to navigate users to the nearest exit. Provided navigation assistance and scene explanation. (Video Demo)

2019 **Visual Memory with Sparse Demonstrations**, *University of Colorado Boulder*.
Investigated LSTM's ability to learn path policies using visual cues, enabling a robot to re-trace paths without a 3D map. (Project Link)

2018 **ARKit App for Learning Disabilities**, *University of Colorado Boulder*.
Developed an iOS app with a Python ML backend that parses text from images and re-presents it intuitively to foster learning. (Project Link)

Technical Skills

AI & LLM / VLM Foundation Models (Qwen, Gemma, PaliGemma, LLaMA), Local Deployment, LM Studio, PyTorch, LangGraph, LangChain

Robotics ROS, SLAM, Particle Filters, WeBots, RViz, Sensor Fusion

Languages Python (NumPy, SciPy), C++, JavaScript, R

Methodologies Human-Subject Experiment Design, Statistical Analysis

Service & Mentorship

Peer Review	Reviewer for ACM/IEEE HRI, IEEE ICRA, IEEE IROS, ACM THRI
Leadership	Social Media Chair (HRI 2024), Volunteer (AAMAS 2023)
Mentorship	Mentored 5 M.S. and 2 Undergraduate researchers; mentees placed at **Tesla**, **Meta**, and **AWS**.

Invited Talks

Apr 2024 **Robotics Seminar Talk: Context-Aware Assistive Guidance**, *University of Colorado Boulder*, Boulder, CO, (Slides).
Presented thesis work on context-aware assistive guidance.

Apr 2024 **Guest Lecture: Practical Computer Vision**, *Franklin & Marshall College*, Lancaster, PA, (Slides).
Guest lecture for Intro to Machine Learning (CPS 360).

Sep 2023 **Leading with Impact alumni event**, Denver, CO, (Event news).
Panel discussion on the current state and future of AI.

Awards and Scholarships

2024	Bell Family Endowed CS Scholarship.
2024	Publication Recognition Award, CU Boulder.
2022, 2023	Conference Support Fellowship, CU Boulder.
2022, 2023	Winner at Annual Research Expo, CU Boulder.
2021-2022	David T. Spalding Graduate Teaching Fund Fellowship.
2019-2020	Best Part-Time Instructor Award.
2017-2019	Outstanding TA Awards.