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SHORT-PAPER

ACAI: Awareness and Consciousness in Artificial Intelligence



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Published: 12 October 2025

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UbiComp '25: The 2025 ACM International Joint Conference on Pervasive and Ubiquitous Computing / ISWC ACM International Symposium on Wearable Computers
October 12 - 16, 2025
Espoo, Finland

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ACAI: Awareness and Consciousness in Artificial Intelligence

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Abstract

The exploration of awareness and consciousness in Artificial Intelligence (AI) has been a central focus of research for decades and remains one of its most complex challenges. Despite significant advancements in sensory processing, pattern recognition, and decision-making, AI systems still lack the deep understanding and adaptability characteristic of true awareness. Integrating awareness into AI systems has the potential to greatly enhance their resilience, adaptability, and capacity for long-term self-development. Such advancements could revolutionize fields like healthcare, robotics, smart infrastructure, and the arts by fostering technologies that truly understand and respond to human needs. This workshop aims to explore the boundaries of AI awareness, focusing on theoretical developments, practical applications, and societal impacts. The one-day event includes a keynote speech, paper presentations, and a panel discussion, providing a comprehensive overview of current research and future directions.

CCS Concepts

• **Human-centered computing** → Ubiquitous and mobile computing systems and tools; Ubiquitous and mobile devices; • **Hardware** → Integrated circuits.

Keywords

Artificial intelligence, awareness, consciousness, radio sensing, distributed learning, integrated circuits

ACM Reference Format:

Si Zuo, Xujun Ma, and Giovanni Iacca. 2025. ACAI: Awareness and Consciousness in Artificial Intelligence. In *Companion of the the 2025 ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp Companion '25)*, October 12–16, 2025, Espoo, Finland. ACM, New York, NY, USA, 4 pages. <https://doi.org/10.1145/3714394.3750573>

1 Introduction

The pursuit of awareness and consciousness in Artificial Intelligence (AI) has been a cornerstone of research for decades, yet it remains one of the most complex and unresolved challenges. While AI systems have achieved remarkable feats in sensory processing, pattern recognition, and decision-making, they lack the depth of understanding and adaptability that characterize true awareness. This gap raises fundamental questions: Can machines ever achieve a form of awareness that goes beyond programmed responses?

And if so, how can we design systems that work beyond mimic awareness?

Awareness, as we understand it, is more than just data processing—it involves context, self-monitoring, and the ability to adapt to dynamic environments. For AI, this means moving beyond rigid algorithms to systems that can reason probabilistically, learn from interactions, and demonstrate a form of "understanding" that aligns with human expectations. However, current frameworks for awareness are heavily influenced by human-centric models, which may not fully unlock the potential of artificial systems. This limitation calls for a paradigm shift: a reimagining of awareness that applies not only to humans but also to machines, robots, and even non-conscious entities.

By embedding awareness into AI, we can create systems that are more resilient, adaptive, and capable of long-term self-development [2–4]. Such systems could revolutionize fields like languages, arts, healthcare, robotics, and smart infrastructure, enabling technologies that truly understand and respond to human needs. Yet, achieving this requires interdisciplinary collaboration, blending insights from AI, cognitive science, philosophy, and engineering to redefine what awareness means in the age of intelligent machines.

2 Scope

This workshop seeks to explore the boundaries of awareness in AI, focusing on its theoretical foundations, practical applications, and societal implications. The scope is structured around three core themes: 1) Beyond Human-Centric Models: developing new frameworks to define and measure awareness in artificial systems, moving beyond traditional human-centric perspectives; 2) Building Trust Through Awareness: investigating how aware systems can demonstrate understanding and adaptability to foster human trust and collaboration; 3) Awareness in Action: exploring real-world applications of aware AI, from self-monitoring smart buildings to adaptive robotics and decision-support systems.

Specifically, smart environments represent a critical intersection of ubiquitous computing, artificial intelligence, and interactive systems. As buildings become smarter and more integrated into our daily lives, advancing their ability to achieve self-awareness and adapt based on the occupants' sentiments becomes increasingly crucial. Thus, it is necessary to facilitate and broadcast advanced studies in intelligent techniques for enabling smart environments to evolve into conscious organisms. The workshop aims to harness the rich domain of distributed sensing, unprecedented sensing accuracy, reconfigurable hardware, and probabilistic reasoning to achieve self-awareness in smart environments.

The workshop will delve into the foundations of artificial awareness, exploring theories and architectures that enable systems to monitor, analyze, and adapt to their environments. A key focus



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ACM ISBN 979-8-4007-1477-1/2025/10
<https://doi.org/10.1145/3714394.3750573>

will be on how these systems can demonstrate social and collective awareness, enabling seamless human-robot interaction and collaborative environments.

In addition to theoretical foundations, the workshop will highlight advances in sensing and perception technologies and explore distributed intelligence and self-aware systems, including techniques for probabilistic reasoning, self-monitoring, and emergent awareness in IoT networks and robotics. Applications of aware systems will be a central theme, with discussions on smart environments, healthcare monitoring, industrial automation, and social robotic. Sustainability and ethical considerations will also be addressed, with a focus on energy-efficient systems, privacy-preserving technologies, and value-aligned AI frameworks.

The Workshop aligns closely with the themes of UbiComp/ISWC 2025, focusing on the intersection of ubiquitous computing, IoT, and sustainability. As the pursuit of awareness and consciousness in AI continues to evolve, this workshop provides a platform for researchers and practitioners to explore how intelligent systems can achieve true self-awareness and adaptability. By integrating cutting-edge advancements in distributed intelligence, sensing technologies, and ethical frameworks, the workshop aims to address critical challenges in creating systems that are not only aware but also sustainable and user-centric.

This workshop originates from the EIC-funded SUST(AI)N project, part of the AWARENESS INSIDE Pathfinder Challenge call ¹, which aims to challenge the scientific community to define and achieve true awareness, exploring the concept beyond just the perception of surroundings or self-awareness [1].

3 Topics of Interest

The topics of interest include -but are not limited- to the following:

- Foundations of Artificial Awareness
 - (1) Theories of consciousness and awareness: Attention Schema Theory (AST), Global Neuronal Workspace (GNW), Predictive Processing, and other cognitive neuroscience models.
 - (2) Architectures for artificial consciousness: computational models of awareness, memory, and decision-making.
 - (3) Social and collective awareness: emergent awareness in multi-agent systems, human-robot interaction, and collaborative environments.
 - (4) Value-Aware AI: ethical frameworks for moral decision-making in autonomous systems.
- Sensing and Perception
 - (1) Advanced sensing technologies: RF-based sensing (radar, WiFi, RFID), audio-based sensing, optical signal processing, and environmental monitoring.
 - (2) Cross-modality data fusion: integrating data from multiple sensing modalities for robust perception.
 - (3) Context-aware systems: adaptive systems that respond to environmental and user context.
- Distributed Intelligence and Self-Aware Systems
 - (1) Distributed learning and probabilistic reasoning: techniques for enabling systems to monitor, analyze, and adapt to their surroundings.

- (2) Self-monitoring and self-evaluation: metacognitive models for performance monitoring and adaptation.
 - (3) Emergent awareness in collectives: collaborative awareness in distributed systems, including robotic swarms and IoT networks.
- Applications of Aware Systems
 - (1) Smart environments: self-aware buildings, smart homes, and offices that adapt to user needs and sentiments.
 - (2) Healthcare: Health monitoring systems with contextual awareness and adaptive decision-making.
 - (3) Industry: Autonomous systems for industrial applications, including predictive maintenance and tool invention.
 - (4) Social robots and assistive technologies: Robots with social awareness and value-aligned decision-making.
 - Sustainability and Ethical Considerations
 - (1) Energy-efficient systems: low-power embedded systems, solar-powered devices, and energy optimization techniques.
 - (2) Privacy and security: Secure authentication, data protection, and communication in IoT networks.
 - (3) Ethical AI: ensuring that aware systems align with human values and societal norms.

4 Technical Program Committee

The technical program committee consists of a distinguished group of experts in various fields related to the awareness and consciousness of AI. Here are the provisional names of the committee members:

- Bing Zhai, Northumbria University, Newcastle upon Tyne, UK.
- Luan Chen, ETIS UMR8051, CY Cergy Paris Université, ENSEA, CNRS, France.
- Luis A. Leiva, University of Luxembourg, Luxembourg.
- Manel Gasulla, Universitat Politècnica de Catalunya, Spain.
- Martin Andraud, UC Louvain, Belgium
- Nihan Kahraman, Yildiz University
- Quintino Francesco Lotito, University of Trento, Italy.
- Siqi Wang, Sorbonne Université, France.
- Yan Liu, Northwestern Polytechnical University, China.

5 Organizing the workshop

5.1 Organizers

Si Zuo is a postdoctoral researcher at Aalto University, Finland. She obtained her PhD from Aalto University in 2024. During her doctoral studies, she conducted research visits at the German Research Center for Artificial Intelligence and UNSW Sydney. Her work focuses on the intersection of wearable sensing, generative models for multimodal time-series data, and privacy protection in IoT devices.

Xujun Ma is a postdoctoral researcher at Télécom SudParis, Institut Polytechnique de Paris, France. He received PhD degree from Southeast University, China, in 2020. He received the second-place best student paper award of 2019 IEEE-IMBioC. His research interests include digital health, wireless sensing, and RF/mmWave IC design for radar and communication.

¹https://eic.ec.europa.eu/eic-funding-opportunities/calls-proposals/eic-pathfinder-challenge-awareness-inside_en

Giovanni Iacca is an Associate Professor of Information Engineering at the Department of Information Engineering and Computer Science of the University of Trento, Italy, where he founded the Distributed Intelligence and Optimization Lab (DIOL). Previously, he worked as a postdoctoral researcher in Germany (RWTH Aachen, 2017-2018), Switzerland (University of Lausanne and EPFL, 2013-2016), and The Netherlands (INCAS3, 2012-2016), as well as in industry in the areas of software engineering and industrial automation. He is co-PI of the PATHFINDER-CHALLENGE project "SUSTAIN" (2022-2026). Previously, he was co-PI of the FET-Open project "PHOENIX" (2015-2019). He has received two best paper awards (EvoApps 2017 and UKCI 2012). His research focuses on computational intelligence, distributed systems, explainable AI, and analysis of biomedical data. In these fields, he co-authored more than 190 peer-reviewed publications. He is actively involved in organizing tracks and workshops at some of the top conferences on computational intelligence, and he regularly serves as a reviewer for several journals and conference committees. He is an Associate Editor for IEEE Transactions on Evolutionary Computation, Applied Soft Computing, Memetic Computing, and Frontiers in Robotics and AI.

5.2 Expected Attendance

We anticipate 20–30 participants, including researchers, industry professionals, and students with diverse expertise—ranging from hardware enthusiasts to software developers and systems builders—who can contribute meaningfully to the field. Participation will be open to all attendees of UbiComp/ISWC 2025, with no restrictions on attendance. We will also livestream the event for participants who wish to join online.

| Time | Details |
|---------------|---------------------|
| 08:45 - 09:00 | Coffee |
| 09:00 - 09:15 | Opening |
| 09:15 - 10:00 | Keynote |
| 10:00 - 10:15 | Coffee Break |
| 10:15 - 11:00 | Paper Presentations |
| 11:00 - 12:00 | Panel Discussion |
| 12:00 - 12:15 | Closing |

Table 1: Workshop Schedule

5.3 Detailed Plan for Conducting the Workshop

Pre-Workshop Preparation: Firstly disseminate the Call for Papers (CFP) through academic mailing lists, social media, and relevant communities; a PCS portal will be set up to manage the submissions; then submissions will be reviewed by a program committee of experts based on originality, technical quality, and relevance to the workshop themes; the workshop agenda will be finalized based on accepted papers and invited talks.

Workshop Activities: The duration of the workshop is expected to be one day, engaging with a keynote session, two paper

presentation sessions, and a panel discussion. The initial schedule is outlined in Table 1.

5.3.1 Keynote. An invited expert will deliver a keynote presentation on the latest advancements in intelligent and sustainable IoT technologies. The talk will highlight innovative approaches to achieving self-awareness in systems, energy-efficient designs, and the ethical implications of aware technologies.

5.3.2 Papers. Submitted papers should be concise, with a maximum length of 4 pages (excluding references and supplementary material). Authors are encouraged to present technical details clearly and effectively, using tools such as bullet points, figures, and tables to enhance readability.

Authors of accepted papers will present their research, with each presentation lasting 15 minutes (including Q&A session). This session will showcase cutting-edge work on topics such as distributed intelligence, advanced sensing technologies, and applications of aware systems in smart environments, healthcare, and industry.

5.3.3 Panel discussion. A panel of leading researchers and practitioners will discuss the challenges, future directions, and open questions in the field of artificial awareness and sustainable IoT systems. The panel will invite an AI researcher who specializes in machine learning and neural networks, providing insights into the computational aspects of developing awareness in AI systems. Joining the discussion will be a cognitive scientist who studies human awareness and consciousness, offering perspectives on how human models can inform AI development and highlighting differences between human and artificial awareness. Additionally, a legal expert specializing in technology law will explore the legal implications of deploying aware AI and IoT systems, addressing issues of liability, regulation, and compliance. This diverse group of panelists will provide a comprehensive discussion on the multifaceted challenges and opportunities in the field.

Post-Workshop Follow-Up: *Publication of Proceedings:* Accepted papers will be published in the ACM Digital Library; *Community Building:* Establish a mailing list or online forum to continue discussions, collaborations, as well as for providing updates on future event. Materials like presentation slides will be available online (e.g., Github), serving as a comprehensive resource for the community.

A Call for Papers (CFP)

The workshop Awareness and Consciousness in Artificial Intelligence 2025 aims to address the challenge in the field of awareness and consciousness in Artificial Intelligence (AI). The pursuit of awareness and consciousness in Artificial Intelligence (AI) has been a cornerstone of research for decades, yet it remains one of the most complex and unresolved challenges. While AI systems have achieved remarkable achievements in sensory processing, pattern recognition, and decision-making, they lack the depth of understanding and adaptability that characterize true awareness. Awareness, as we understand it, involves more than just data processing—it requires context, self-monitoring, and the ability to adapt to dynamic environments. For AI, this means moving beyond rigid algorithms to systems that can reason probabilistically, learn from interactions, and demonstrate a form of "understanding" that aligns

with human expectations.

Scope of the Workshop

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We invite submissions on the following topics, though other relevant subjects will also be considered:

- Foundations of Artificial Awareness
 - (1) Theories of consciousness and awareness: Attention Schema Theory (AST), Global Neuronal Workspace (GNW), Predictive Processing, and other cognitive neuroscience models.
 - (2) Architectures for artificial consciousness: computational models of awareness, memory, and decision-making.
 - (3) Social and collective awareness: emergent awareness in multi-agent systems, human-robot interaction, and collaborative environments.
 - (4) Value-Aware AI: ethical frameworks for moral decision-making in autonomous systems.
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- Nihan Kahraman, Yildiz University
- Quintino Francesco Lotito, University of Trento, Italy.
- Siqi Wang, Sorbonne Université, France.
- Yan Liu, Northwestern Polytechnical University, China.

Submission Guidelines

We invite researchers and practitioners to submit papers addressing the aforementioned topics. Submitted papers should be concise, with a maximum length of 4 pages (excluding references and supplementary material). The submitted paper should use the UbiComp/ISWC 2025 proceedings format. All submitted papers will be reviewed and judged on originality, technical correctness, relevance, and quality of presentation. All submissions will be peer-reviewed by at least two reviewers. Accepted papers will be presented at the workshop and will appear in the ACM Digital Library.

Important Dates:

- (1) Submission Deadline: June 22, 2025
- (2) Notification of Acceptance: July 22 2025
- (3) Camera-Ready Submission: July 30 2025
- (4) Workshop Date: October 13 2025

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