Summary and objectives: As robots become more integrated into our daily lives, they must increasingly deal with situations in which socially appropriate interaction is vital. In such settings, it is not enough for a robot simply to plan its actions to perform particular tasks; instead, the robot must also be able to satisfy social goals and obligations that arise through interactions with people in real-world settings. As a result, a robot requires not only the necessary physical skills to perform tasks in the world, but also the appropriate social skills to understand and respond to the needs and intentions of the people it interacts with.

The goal of the JAMES project—Joint Action for Multimodal Embodied Social Systems—is to develop an artificial embodied agent that supports socially appropriate, multi-party, multimodal interaction. JAMES focuses on the qualitative aspects of task achievement in social situations, and how such tasks can be improved through multimodal communication, rather than the physical aspects of traditional robotics tasks. In particular, JAMES is developing the core cognitive capabilities that enable a robot to interact with humans in a socially-appropriate manner in real-world, dynamic, task-oriented contexts, by focusing on five objectives:

- To record and analyse the social and task-based behaviour of humans engaged in multimodal joint activities, using a novel Ghost-in-the-Machine data-collection paradigm.
- To design and train a model of social interaction, using annotated data from the human experiments. This model will estimate the social and task-related goals of human partners by processing visual and auditory inputs, and will generate appropriate responses through physical and linguistic actions.
- To endow the model of social interaction with the ability to learn and adapt to human behaviours, and to handle partial or uncertain information about the state of the world and the mental states of human users.
- To implement the model of social interaction on a physical robot platform, which can operate in an environment with multiple, dynamically changing interaction partners.
- To evaluate the implemented robot system through physical and simulated interactions with at least two simultaneous human users in a social, task-oriented setting.

The specific demonstration of this work will be a bartender scenario, where the robot will play the role of a bartender responding to customers’ requests in a dynamic setting, with multiple customers and short interactions. Interactions in the target scenario will incorporate a mixture of task-based behaviours (e.g., ordering and paying for drinks) and social behaviours (e.g., engaging in social conversation, managing multiple simultaneous interactions), both of which present challenges for the JAMES project: a robot existing in the physical world must be able to understand and respond to both the social and the task-based needs of the humans that it encounters, and to successfully distinguish them from each other.
**Current progress:** Achieving the objectives of JAMES requires an interdisciplinary approach to research, building on ideas from a number of core fields. To this end, JAMES is building on state-of-the-art techniques in seven areas of research: social robotics, vision, natural language interaction, social signal processing, machine learning, planning, and multimodal data collection. Developments in these diverse areas of research all contribute to the project’s novel and ambitious goal: a robot with the ability to recognise, understand, and interact with multiple humans in a dynamic, real-world social setting.

During the first two years of the project, significant progress has been made on all objectives. JAMES has produced an extensive number of scientific outputs, met all its planned milestones, and undertaken important dissemination activities. Highlights of this work include:

- A second-generation prototype of the bartending robot has been built, integrating major theoretical and technical developments from the project’s core research areas on the JAMES robot, and demonstrating a vision of the project’s overall goals. A video is available at: [http://youtu.be/8k7Pd-CbbhE](http://youtu.be/8k7Pd-CbbhE).
- Two evaluations of the JAMES robot system involving human users have been completed.
- A corpus of video data has been collected and analysed, featuring over 100 interactions between real customers and bartenders in Germany. Additional experiments on intention recognition and studies investigating human interaction using a novel Ghost-in-the-Machine paradigm have also been performed.
- As a whole, JAMES has produced over 50 scientific papers, given 14 invited talks and presentations, organised tutorials based on its findings as part of engagement with the research community, and been featured in numerous media contexts on television, in newspapers, on the radio, and on the web.

Building on these successes, the project’s final phase will see a continuation of all lines of research culminating in a sophisticated robot system capable of interacting with humans in complex social scenarios.

**Expected outcomes:** JAMES has the potential to directly influence the design of future systems that will be deployed as service robots, companion agents, or in other environments where natural interaction with humans is essential. In meeting the objectives of JAMES, we anticipate developments in all research areas of the project. Potential contributions include:

- A new method for creating a corpus of multimodal, dynamic, multi-party interactions,
- A vision system that is able to track multiple people in a social setting,
- Novel formal representations of user and world states that are richer than those in use in similar domains,
- A clear model of the information necessary for robots to reliably recognise communicative intentions,
- New applications of statistical learning and context modelling techniques for social interactive systems,
- Improved knowledge-level planning algorithms for action selection in social state spaces, and
- A set of robot movements that appear natural to humans to facilitate human-robot interactions.

Early results have produced advances and working prototypes in each of the project’s core research areas, some of which have been transferred to research activities beyond JAMES. Further knowledge transfer, beyond traditional research circles, is anticipated as the project progresses.

The JAMES consortium consists of partners from the University of Edinburgh (UK), fortiss GmbH (Germany), Heriot-Watt University (UK), Universität Bielefeld (Germany), and the Foundation for Research and Technology – Hellas (Greece). For more information, visit the JAMES website at [http://james-project.eu](http://james-project.eu).