Engineers developing a HAL 9000-type AI system for monitoring planetary base stations

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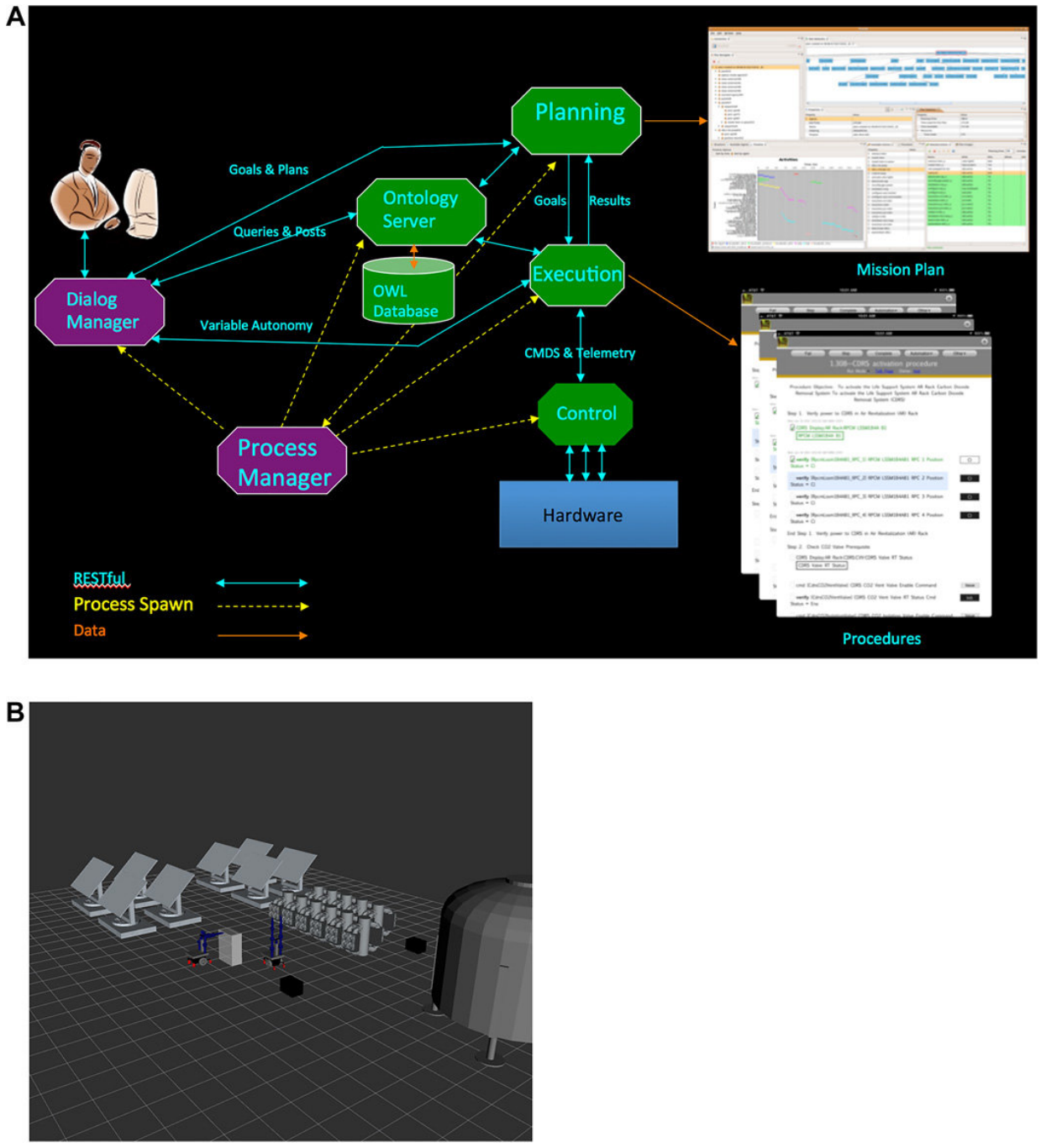

Fig. 1 An intelligent agent, like HAL 9000. (A) The top-level CASE architectural design. The planner generates an activity plan whose actions are procedures run by the execution system, which, in turn, interfaces to the hardware through the control software. The planning and execution systems draw information from and update the system ontology, a smart database. A process manager spawns the main components of the system and reconstitutes processes

if their supporting computing infrastructure fails. The user interacts with the agent through a dialog manager. (B) The planetary base rendered in our robot visualization system (wiki.ros.org/rviz). The robot at the control panel connects solar panels (in the background) to batteries (right mid-ground) and batteries to power boxes (black boxes) that, in turn, connect to the habitat (right foreground). The second robot carries out find and fetch tasks. Credit: *Science Robotics* (2018). DOI: 10.1126/scirobotics.aav6610

A team of engineers at TRACLabs Inc. in the U.S. is making inroads toward the creation of a planetary base station monitoring system similar in some respects to Hal 9000—the infamous AI system in the movie *2001: A Space Odyssey*. In this case, it is called cognitive architecture for space agents (CASE) and is outlined in a Focus piece by Pete Bonasso, the primary engineer working on the project, in the journal *Science Robotics*.

Bonasso explains that he has had an interest in creating a real Hal 9000 ever since watching the movie as a college student—minus the human killing, of course. His system is designed to run a base situated on another planet, such as Mars. It is meant to take care of the more mundane, but critical tasks involved with maintaining a habitable planetary base, such as maintaining oxygen levels and taking care of waste. He notes that such a system needs to know what to do and how to do it, carrying out activities using such hardware as robot arms. To that end, CASE has been designed as a three-layered system. The first is in charge of controlling hardware, such as power systems, life-support, etc.

The second layer is more brainy—it is in charge of running the software that controls the hardware. The third layer is even smarter, responsible for coming up with solutions to problems as they arise—if damage occurs to a module, for example, it must be sealed off from others modules as quickly as possible. The system also has what Bonasso

describes as an ontological system—its job is to be self-aware so that the system can make judgment calls when comparing data from sensors with what it has learned in the past and with information received from human occupants. To that end, the system will be expected to interact with those humans in ways similar to those portrayed in the movie.

Bonasso reports that he and his team have built a virtual reality prototype of a planetary base, which CASE has thus far managed to run for up to four hours. He acknowledges that a lot more work needs to be done. Luckily, they still have a lot of time, as plans for human habitation of Mars and beyond are still decades away.

More information: Pete Bonasso. CASE: A HAL 9000 for 2021, *Science Robotics* (2018). DOI: 10.1126/scirobotics.aav6610