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# LUNAR ROVERS AND LOCAL POSITIONING SYSTEM

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Telerobotic rovers equipped with adequate actuators and sensors are clearly necessary for extraterrestrial construction. They will be employed as substitutes for humans, to perform jobs like surveying, sensing, signaling, manipulating, and the handling of small materials. Important design criteria for these rovers include versatility and robustness. They must be easily programmed and reprogrammed to perform a wide variety of different functions, and they must be robust so that construction work will not be jeopardized by parts failures. The key qualities and functions necessary for these rovers to achieve the required versatility and robustness are modularity, redundancy, and coordination.

Three robotic rovers are being built by CSC as a testbed to implement the concepts of modularity and coordination. The specific goal of the design and construction of these robots is to demonstrate the software modularity and multi-robot control algorithms required for the physical manipulation of constructible elements. Each rover consists of a transporter platform, bus manager, simple manipulator and positioning receivers. These robots will be controlled from a central control console via a radio-frequency local area network (LAN).

To date, one prototype transporter platform frame has been built with batteries, motors, a prototype single-motor controller, and two prototype internal LAN boards. Software modules have been developed in C language for monitor functions, i/o, and parallel port usage in each computer board. Also completed are the fabrication of half of the required number of computer boards, the procurement of 19.2 Kbaud RF modems for inter-robot communications, and the simulation of processing requirements for positioning receivers. In addition to the robotic platform, the fabrication of a local positioning system based on infra-red signals is nearly completed. This positioning system will make the rovers into a moving reference system capable of performing site surveys. In addition, a four-degree mechanical manipulator especially suited for coordinated teleoperation has been conceptually designed and is currently being analyzed. This manipulator will be integrated into the rovers as their end effector.

We are now using 20 internal LAN cards fabricated by a commercial firm, have built a prototype manipulator and a range finder for a positioning system, have designed a prototype two-motor controller, and have one of the robots performing its first telerobotic motion. In addition, we have coordinated and tested the robots' internal LANs, have completed hardware design upgrades based on fabrication and fit experience, and have the positioning system running. The rover system is able to perform simple tasks such as sensing and signaling; coordination systems which allow construction tasks to begin have been established, and soon coordinated teams of robots in the laboratory will be able to manipulate common objects.

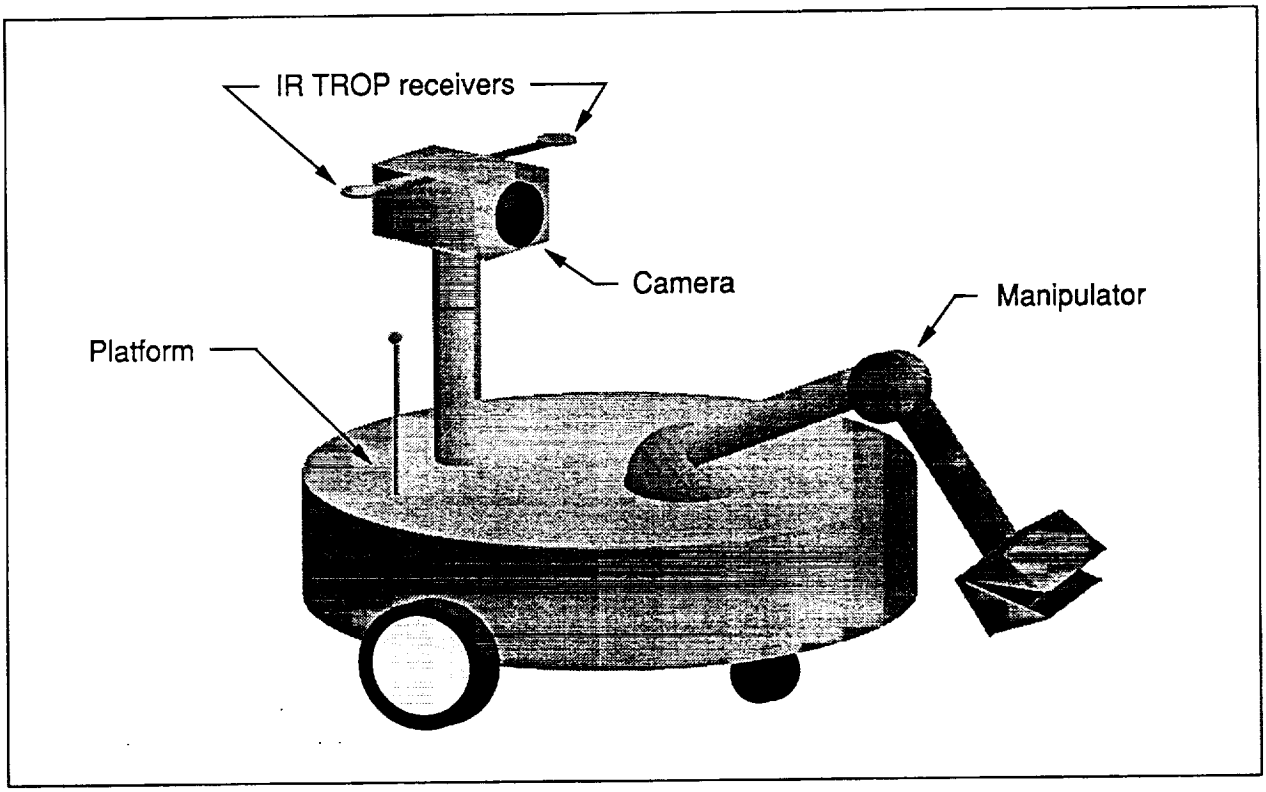


*Fig 11.1 Modular robot*

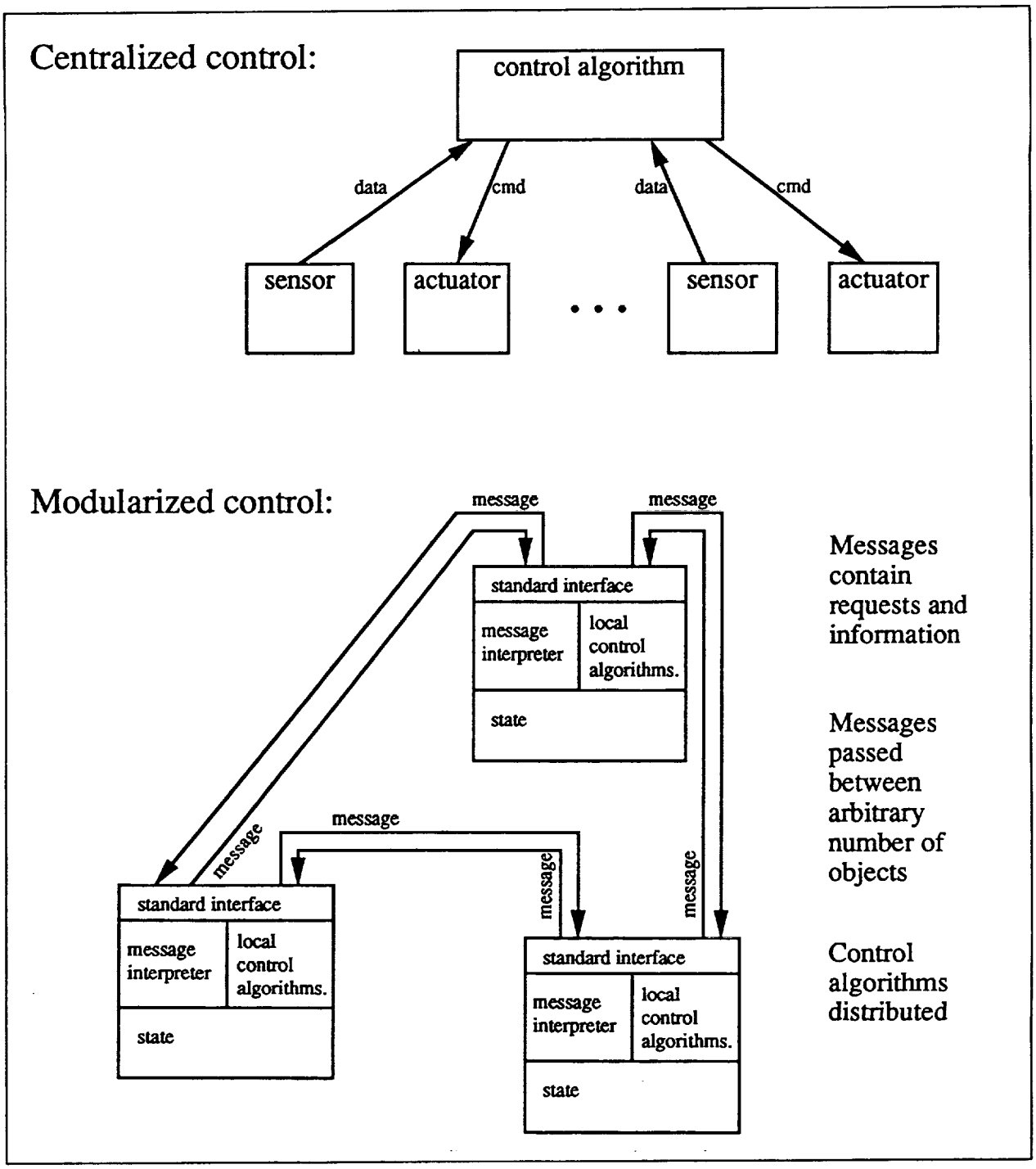


*Fig 11.2 Centralized vs. modularized control*

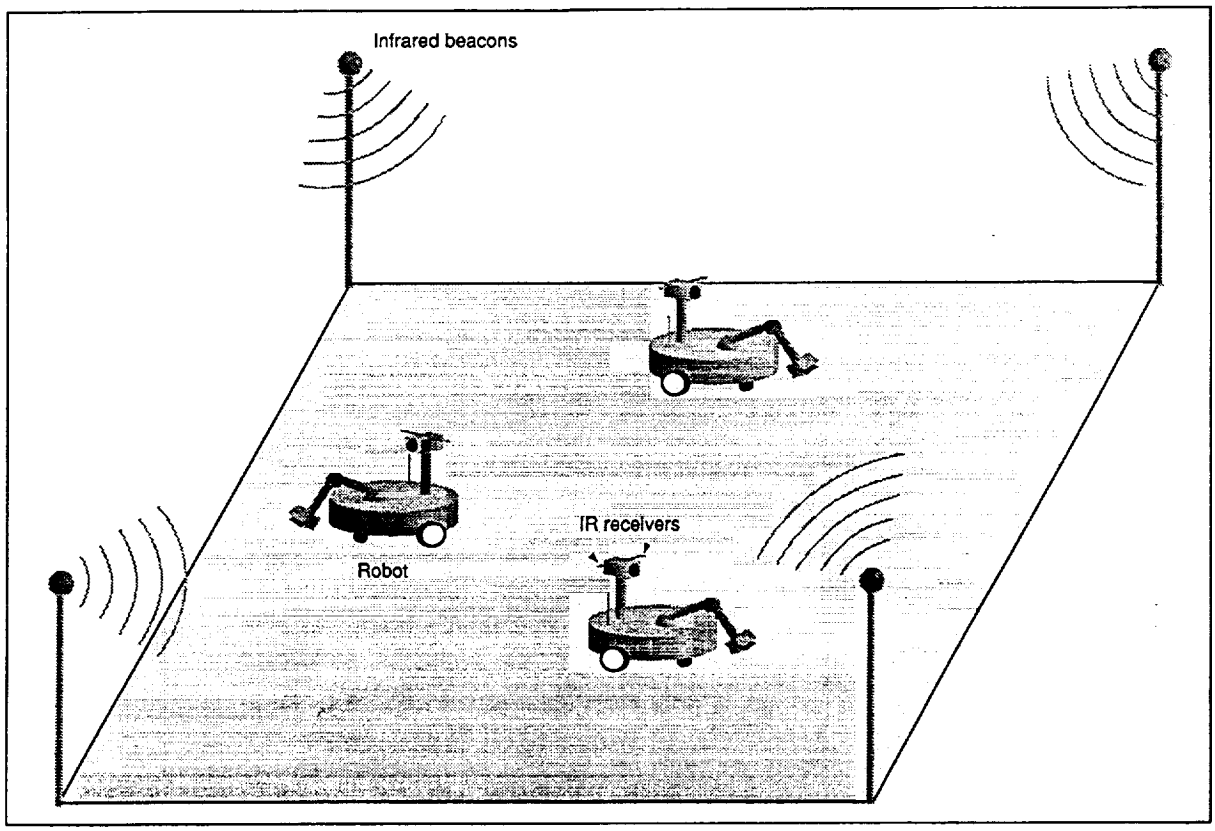


*Fig 11.3 IR TROP system components and cooperating configuration*

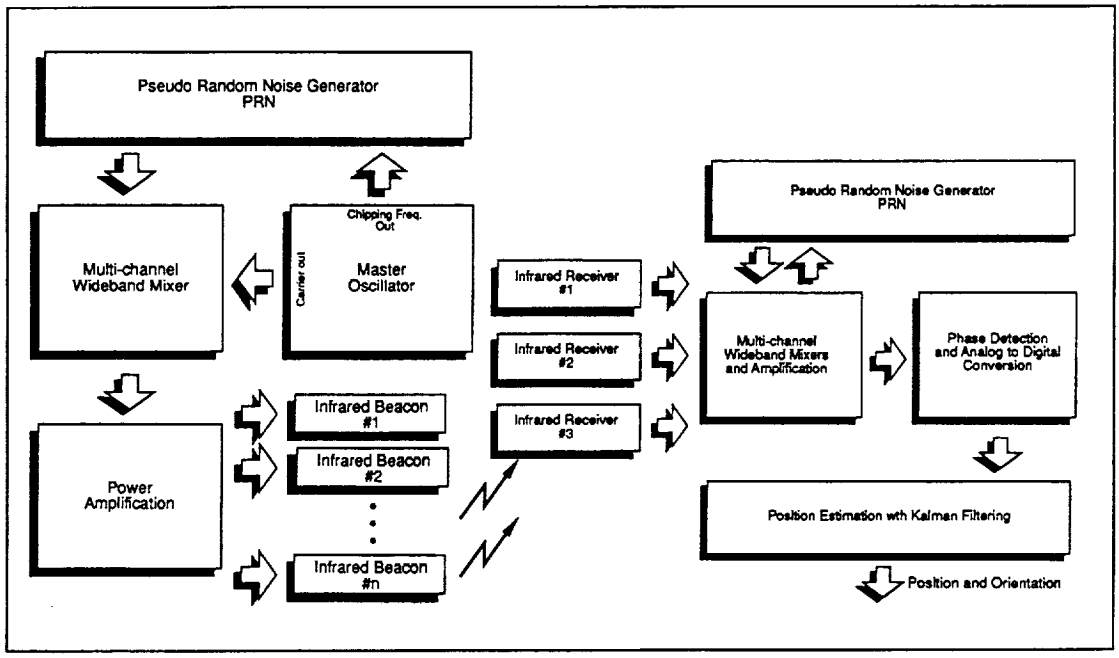


*Fig 11.4 IR TROP system concept*