Lomu, an Autonomous Mobile Robot with Robust Architecture and Components

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Abstract

The Laboratory for Robotics and Automation (LaRA) at HESSO-HEIG has developed several autonomous mobile robots with original architecture and control structure. These robots have entered numerous EUROBOT competitions at Swiss and/or European levels. The paper describes a mobile autonomous robot named "Lomu", which is the most recent offspring of our design. The main aspects of Lomu appear to be as much as possible, the off-the-shelf nature, preferably industrial, of its components; the excellence and modularity of software and hardware agents; and when technical functionality and operational reliability are fully ensured, the ease of supply and lean cost value.

Lomu includes a number of sophisticated components for communication and control. For information flows, there are two key architectural ingredients : 1. a data Hub and Ethernet TCP/IP protocol at hardware level, with data rate of 100 Mbit/s and 2. our proprietary real-time, embedded, multi-agent "Piaget" environment, at higher abstraction, cognitive level, with 100 nanosecond duration time-slots in average.

The major hardware components notably include kinematically simple (at mechanical level) locomotion platform (2 motorized wheels), powerful decisional organ (very compact notebook computer running XP-Pro), computerized wide-angle color-camera, Modbus compatible, IEC-1131 programmable controller with field-compatible input conditioning and output power circuits, specialized motion controller with trajectory interpolation and DC-motor servoing, numerous industrial-grade ultrasound and optolelectronic sensors. Communication is sure, effective, highly flexible. This architecture makes it easy, if necessary, to replace wihout extensive redesign an element by another, to add or to remove elements. Robot programming and trajectory management is carried out in "Piaget" context, which is implemented in C++ language for this case. Notably, Piaget includes application-oriented primitives, in order to allow for fluent programming and fast reconfiguration between matches, as well as industrial-grade types of instructions (re. Unimation-Stäubli V+) for early design phases. The system capitalizes on past developments, notably Stephane Amiguet's inverse kinematic approach (1998), Sylvain Charmillot's vision processing (2002), and Julien Luthi's PLC management objects (2004).

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