Development of the software architecture of a mobile robot

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Abstract

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Development of the software architecture for a mobile robot

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This master's thesis focuses on building a software infrastructure for a unique form of humanoid robot, developed within the RoboCup competition framework. The primary aim was to integrate a real-time operating system, such as Preempt-RT, Xenomai, or RTAI, to minimize latency and optimize system performance. An appropriate Linux distribution was also chosen as the software development base. Following a thorough evaluation based on various criteria, including latency, Preempt-RT was selected as the real-time operating system, accompanied by the Fedora distribution, chosen for its minimal size.

The second part of this thesis concentrates on establishing efficient communication between electronic and software components. The chosen communication mode is USB (Universal Serial Bus), and results demonstrate satisfactory data transfer between these components.

The third part involves implementing an event logging system, based on four selectable log levels by the user, enabling quick issue tracking and resolution during robot program execution. Recorded logs are detailed, including time down to the nanosecond, message level, content, as well as the relevant line and file. Users can select the base level, filtering logged messages into a file located in a specific directory.

Furthermore, robust interfaces for task creation and inter-task communication have been designed to meet future needs. The primary goal was to optimize the efficiency and responsiveness of information exchange, thus contributing to the overall robot performance. The task-related interface facilitates the creation of tasks, assigning priorities and periods as needed, and, if required, assigning them to a designated processor core. The second interface enables tasks to communicate with each other: if a task requires another task's content, it can request and receive it once available. During this content wait, the task is paused to conserve processor resources.

To conclude, this thesis has established a robust software infrastructure for a humanoid robot intended for the RoboCup competition. Through the selection of Preempt-RT and Fedora, system performance has been optimized. The use of USB for communication and the implementation of a logging system have also been validated. The interfaces created for task management and communication meet future needs for efficiency and responsiveness.