Real time communications in a small biped robot YABIRO.

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Abstract

In this paper we present a real time architecture for embedded control systems to be used into a mobile biped robot called YABIRO[1]. YABIRO is an anthropomorphic small biped robot with a total of 14 DoF (Degrees of Freedom). Its mechanical structure gives us enough mobility, enabling us to produce many different gait configurations, being also suitable to test and validate the proposed real time control architecture. The joints are distributed as follows: two in the ankle, one in the knee, three in the hip and two in the torso. Many biped robot designs have been implemented with a similar structure.

The YABIRO communication bus protocol is based on Time Triggered CAN (TTCAN) protocol, witch is another extension of CAN, based on static schedule TDMA. The TTCAN protocol has a series of features that have been adapted to YABIRO control structure. For this purpose we define a unique window transmission, being a periodic task. The basic period time has been defined in 30msec, this means that all the control systems inside YABIRO will work synchronized with this window time. With this communication architecture we obtain a zero jitter in the control messages and other high priority messages, improving the dynamical robot behaviour.

A new embedded intelligent motor controller driver (IMCD) has been also designed and implemented into each joint node of the distributed architecture, to work inside the real time network. YABIRO uses powerful model making commercial servos, but despite of their advantages, the use of commercial servo motors presents an important problem: the lack of feedback signals. A position feedback cannot be obtained from a conventional servomotor. This signal is very important if the robotic platform wants to achieve an accurate position control in each joint. This IMCD board try to solve this problem, usual in low cost biped robots and with this design we improve the communications and control architecture of YABIRO. Inside of the IMCD board, two main tasks have been programmed: a real time CAN bus protocol, and a PD controller which guarantees an accurate joint position control.

Finally a main control node runs different tasks such as: deliberative system control, sensor fusion, human interface, robot system supervision, and so on. To carry out some of these tasks, YABIRO includes a multi-tasking real time control platform, based on a Transmeta Crusoe processor board, where RTLinux 3.0 real time kernel is running. The use of this kernel together with a Linux 2.4.18 kernel makes possible the division between critical tasks and other tasks into the same control system. For this reason we have used a layered distribution based on different task requirements. YABIRO runs a great number of different tasks, with different time restrictions and periodicity.

[1] YABIRO stands for Yet Another BIped RObot, and is currently being developed with funds from the projects DPI 2002-04434-C04-03 from Spanish FEDER-CICYT, and the GV04B-392.