Integrated Sensor and Controller Framework

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Abstract

This thesis presents a software platform to integrate sensors, controllers, actuators and instrumentation within a common framework. This provides a flexible, reusable, reconfigurable and scalable system for designers to use as a base for any sensing and control platform.

The purpose of the framework is to decrease system development time, and allow more time to be spent on designing the control algorithms, rather than implementing the system.

The architecture is generic, and finds application in many areas such as home, office and factory automation, process and environmental monitoring, surveillance and robotics.

The framework uses a data driven design, which separates the data storage areas (dataslots) from the components of the framework that process the data (processors). By separating all the components of the framework in this way, it allows a flexible configuration. When a processor places data into a dataslot, the dataslot queues all the processors that use that data to run.

A system that is based on this framework is configured by a text file. All the components are defined in the file, with the interactions between them. The system can be thought of as multiple boxes, with the text file defining how these boxes are connected together. This allows rapid configuration of the system, as separate text files can be maintained for different configurations. A text file is used for the configuration instead of a graphical environment to simplify the development process, and to reduce development time.

One potential limitation of the approach of separating the computational components is an increased overhead or latency. It is acknowledged that this is an important consideration in many control applications, so the framework is designed to minimise

the latency through implementation of prioritized queues and multitasking. This prevents one slow component from degrading the performance of the rest of the system.

The operation of the framework is demonstrated through a range of different applications. These show some of the key features including: acquiring data, handling multiple dataslots that a processor reads from or writes to, controlling actuators, how the virtual instrumentation works, network communications, where controllers fit into the framework, data logging, image and video dataslots, timers and dynamically linked libraries. A number of experiments show the framework under real conditions. The framework's data passing mechanisms are demonstrated, a simple control and data logging application is shown and an image processing application is shown to demonstrate the system under load. The latency of the framework is also determined. These illustrate how the framework would operate under different hardware and software applications. Work can still be done on the framework, as extra features can be added to improve the usability.

Overall, this thesis presents a flexible system to integrate sensors, actuators, instrumentation and controllers that can be utilised in a wide range of applications.

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List of Figures

Key for Figures

Below in Figure 1 is a key for most of the figures in this thesis.

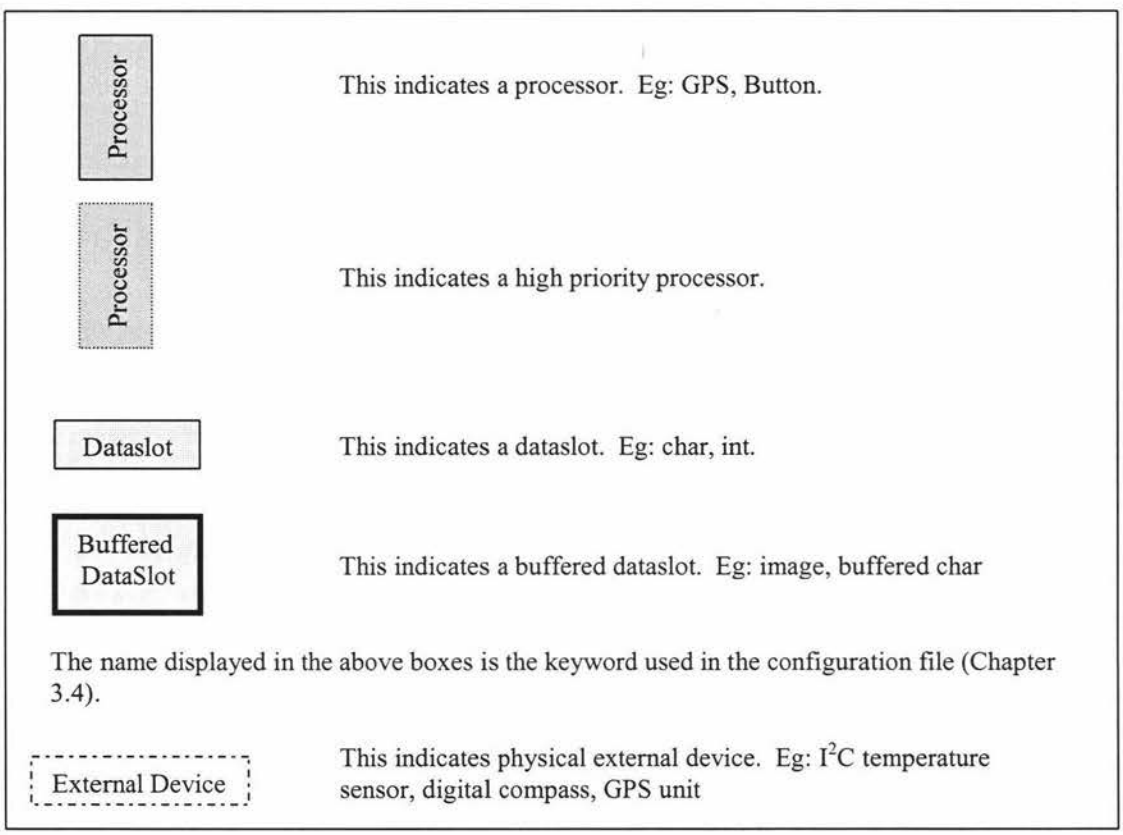

Figure 1: Key for most figures in this thesis.

List of Tables

Table of Contents