Computer Architecture and Interfacing to Mechatronic Systems

by
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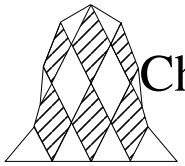

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Author

Dr. Dario Toncich was born in Melbourne Australia in 1960. He graduated (with honours) in Electrical Engineering from the University of Melbourne in 1983. Since that time he has held both industry and academic positions and has experience in the fields of data communications, computer architecture, FMS control and simulation.

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Introduction

Very few systems in modern engineering are either purely mechanical or purely electronic in nature. Most engineering devices, machines and systems are a combination of mechanical elements, computer controls and the electronic interfacing circuitry that binds these elements together. In the mid-1980s, these hybrid systems were recognised as being a rapidly growing part of the engineering world and were given the rather commercial, but nonetheless appropriate, title of "mechatronic" systems. It is somewhat ironic that the two fields of engineering (electronic and mechanical) that were derived from the classical mechanical engineering streams of the early 19th century have now had to be brought back together as a result of the growing need for mechatronic systems.

A mechatronic system can have many forms. At a domestic level, it could be a compact-disk player or a video recorder. At an industrial level, a mechatronic system could be a robot, a computer controlled production machine or an entire production line. The extraordinary increase in low-cost processing power that has arisen as a result of the microprocessor now means that few mechanical devices in the modern world are born without some form of intelligence.

The problem that most engineers now face is that their undergraduate courses have simply not equipped them to undertake the task of designing mechatronic systems. Mechanical and manufacturing engineers seldom understand enough about electronic engineering and computing concepts to tackle the inter-disciplinary realities of system design. Electrical and electronics engineers similarly understand very little about the mechanical systems for which they design computer controls and interfaces.

It is surprising therefore, that in this day and age we still retain separate courses for electronic and mechanical engineering - and yet the trend towards greater specialisation is unfortunately continuing. The common university argument is that in order to be a good electronic or mechanical engineer, one needs to have a highly specialised undergraduate program. The reality is that in order to be a good engineer, one needs to have a good understanding of both mechanical and electronic engineering disciplines and a degree of specialisation that is born of practical realities, rather than esoteric theories.

The purpose of this book is to address the links that need to be bridged between modern electronic and mechanical equipment. In other words, we look at the issue of what a mechanical or manufacturing engineer needs to know in order to sensibly design mechatronic systems. We also introduce the basic concepts that electrical / electronics engineers will need to understand when interfacing computer systems to mechanical devices.

Computer Architecture and Interfacing to Mechatronic Systems is not an exhaustive applications guide for computer interfacing and systems design. The issues that have been selected for discussion in this book are wide-ranging and at first glance may appear to be somewhat unusual. However, a great deal of thought has gone into the structure of this book so that mechanical, manufacturing and even chemical engineers can come to terms with the electronics, computers and control systems that are used to drive mechatronic systems. Similarly, electronics engineers will find that the book summarises the basic concepts that they have learnt in their undergraduate engineering courses and places this knowledge into perspective with the mechanical devices to which they must tailor their designs.

In the final analysis, only a small percentage of engineers will undertake a complete interfacing exercise from first principles. Many would argue that there is little need for such developments in light of the number of commercially available building blocks that can be used to interface computers to the outside world. However, even if one accepts that interfacing is gradually (and fortunately) becoming a systems engineering task, one must also accept that this task cannot be undertaken without a sound understanding of the basic principles and limitations of the building blocks involved. It is to be hoped that this book will give you an understanding of those principles and limitations.

How to Read and Use This Book

"Computer Architecture and Interfacing to Mechatronic Systems" is one of a series of books that has been designed to enable electrical, mechanical and manufacturing engineers to tackle mechatronic systems design and to enable electronic engineers to understand the realities of the industrial devices around which computer controls and interfaces must be designed. The other text book, currently released in the same series is:

> Toncich, D.J., "Data Communications and Networking for Manufacturing Industries (Second Edition)", 1993, Chrystobel Engineering,
> ISBN 0 646 10522 1

These books have been designed with a view to bringing together all the major elements in modern industrial mechatronic equipment, including robotics, CNC and Flexible Manufacturing Systems (FMSs). If you are a mechanical or manufacturing engineer, then this is probably the first of the books that you should read.

All the books in the series feature a similar format, in the sense that they have modular chapters which can be read in isolation from other chapters in the same book. All books in the series have overlapping sections, to enable modules to be covered in their entirety and to allow readers to migrate from one text to another with reinforcement of critical issues at appropriate points.

The writing style of all books in the series is such that each chapter begins in a qualitative form and then introduces equations and technical detail only after the broad concepts have been described. For this reason, you should find "Computer Architecture and Interfacing to Mechatronic Systems" to be a very readable text. Each chapter begins with a summary and a diagram of the overall interfacing process that this text has set out to address. The parts of the interfacing diagram that are most relevant to the chapter are shown in bold text and heavy lines, while the remainder are shown in normal text and dotted lines. The diagram should assist you in understanding where each chapter fits in to the global issues of this text book.

This particular book has been written in a chapter (module) sequence that is felt to be the most suitable for learning the concepts to which the title alludes. You may feel that the contents of a particular chapter are already familiar to you and hence you may choose to omit that chapter. However, be judicious in omitting chapters - the time spent reading an additional chapter will more than be recovered if it assists you in understanding the concepts of a following chapter by refreshing your memory on subject areas that you may have forgotten (or misunderstood at undergraduate level).