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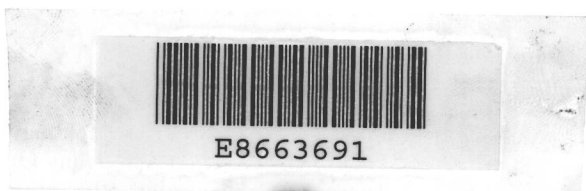
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# SMART ROBOTS

A HANDBOOK OF  
INTELLIGENT ROBOTIC  
SYSTEMS

V. Daniel Hunt  
*President,*  
*Technology Research Corporation*



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# SMART ROBOTS



Other Advanced Automation Books  
by V. Daniel Hunt

- *Industrial Robotics Handbook*
- *Robot Justification Guide*
- *Dictionary of Advanced Automation*
- *Fundamentals of Industrial Robotics*

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*Dedication*  
**To Janet**



# PREFACE

Here is one of the first really thorough presentations on smart robots. Robots, machine vision systems, sensors, manipulators, expert systems, and artificial intelligence concepts combined in state-of-the-art computer integrated manufacturing systems. These "smart" robots increase productivity and improve the quality of our products.

This comprehensive volume, which is extensively illustrated, provides a unique synthesis and overview of the emerging field of smart robots, the basic approaches for each of the constituents systems, the techniques used, applications, the descriptions of current hardware or software projects, a review of the state-of-the-art of the technology, current research and development efforts, and trends in the development of smart robots. All of the information has been compiled from a wide variety of knowledgeable sources and recent government reports. An extensive selection of photographs, diagrams and charts amplify this book.

The contents of major chapters include:

- Introduction to smart robots
- Artificial intelligence for smart robots
- Smart robot systems
- Sensor-controlled robots
- Machine vision systems
- Robot manipulators
- Natural language processing
- Expert systems and
- Computer integrated manufacturing

*Smart Robots* presents the state-of-the-art in intelligent robots. It is designed to help the reader develop an understanding of industrial applications of smart robots as well as the new technological developments. *Smart Robots* is an outstanding introduction to the integration and application of machine vision systems, sensors, expert systems, and artificial intelligence technology. This book is useful for manufacturing

engineers and managers interested in learning more about smart robots which can increase productivity and reduce manufacturing costs. Its glossary of terms, bibliography, points of contact, and index provide an excellent easy reference to specific topical information.

V. Daniel Hunt  
*Fairfax Station, Virginia*



# ACKNOWLEDGMENTS

The information in *Smart Robots* has been compiled from a wide variety of authorities who are specialists in their respective fields.

I wish to thank Dr. William B. Gevarter of the National Bureau of Standards for his research, synthesis, and PUBLICATION of information on intelligent robot systems.

The following public domain publications were used as the basic technical resources for this book.

- *An Overview of Artificial Intelligence and Robotics*, Volumes 1 and 2, National Aeronautics and Space Administration, June 1983, NASA-TM-85836.
- *An Overview of Computer Vision*, US Department of Commerce, September 1982, PB83-217554.
- *An Overview of Computer-Based Natural Language Processing*, National Bureau of Standards, April 1983, PB83-200832.
- *Overview of Expert Systems*, National Bureau of Standards, October 1982, PB83-217562.
- *Flexible Manufacturing System Handbook*, Volumes 1-4, Charles Stark Draper Laboratories, NTIS, ADA-127927, February 1983.

The preparation of a book of this type is dependent upon an excellent staff, and I have been fortunate in this regard. Karen L. Ackerman has effectively served as technical editor of this book and has also carefully proofread the text. Special thanks are extended to Janet C. Hunt for research assistance, and Margaret Kubatz of Wordcom, Inc. for the manuscript word processing.

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# 1

## INTRODUCTION TO SMART ROBOTS

### THE BOOK

This book provides an overview of artificial intelligence integrated into smart robot systems. It describes the synergistic impact of artificial intelligence on robotics. It describes current robot systems which have artificial intelligence capabilities, with particular attention being paid to the use of machine vision systems integrated into robot workcells to substantially increase the effectiveness of a smart robot as shown in Fig. 1-1. The capabilities of a variety of sensors including tactile, range, and proprioceptors will be described. The development of moving robots referred to as locomotion will be briefly covered. Computer-based natural language processing and understanding is a key to enabling people and their

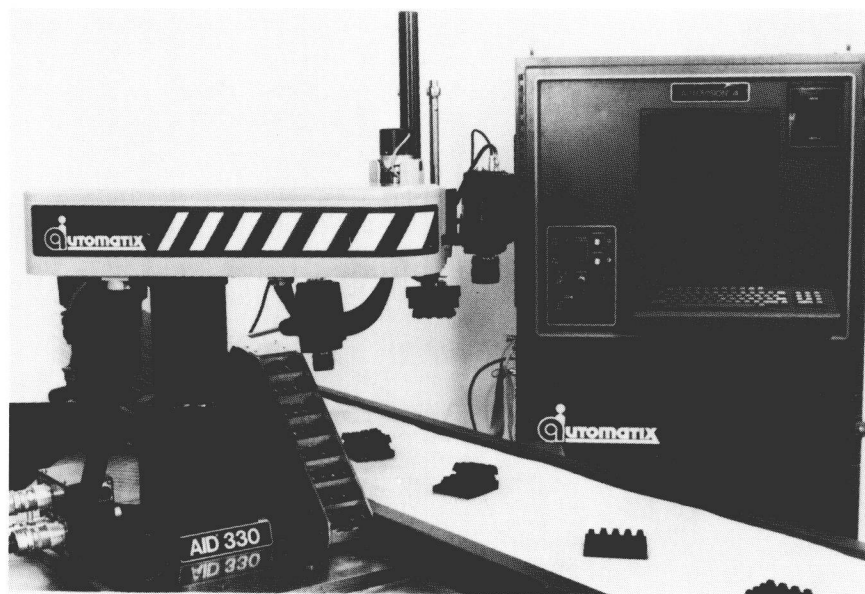


Fig. 1-1. Automatix AID® 300 Series smart robot with Autovision 4 machine vision system.



creations to interact with smart robots. This book provides a synopsis of the basics of expert systems and their use in smart robots. This book has been written in discrete chapters to facilitate review of specific elements of smart robot systems.

### ARTIFICIAL INTELLIGENCE AND ROBOTS

A “smart” or intelligent robot should be able to think, sense, move, and manipulate material, parts, tools or specialized devices through variable programmed motion for the performance of a variety of tasks.

The thinking or “brain function”, executed by a computer, is the domain of artificial intelligence. Sensing and manipulation are “body functions”; they are based on physics, mechanical engineering, electrical engineering, and computer science. Planning and execution of tasks entail both the brain and the body, and so are affected by both artificial intelligence and robotics.

Artificial intelligence and robotics are really in their infancy, but their promise is great. Some practical applications of this research are appearing, although in most cases they are limited and aimed at solving specific problems. Current effort is directed towards extending the capabilities of current applications and finding more general solutions to the problems they address.

Figure 1-2 can be viewed as a simplified model of a smart robot system.

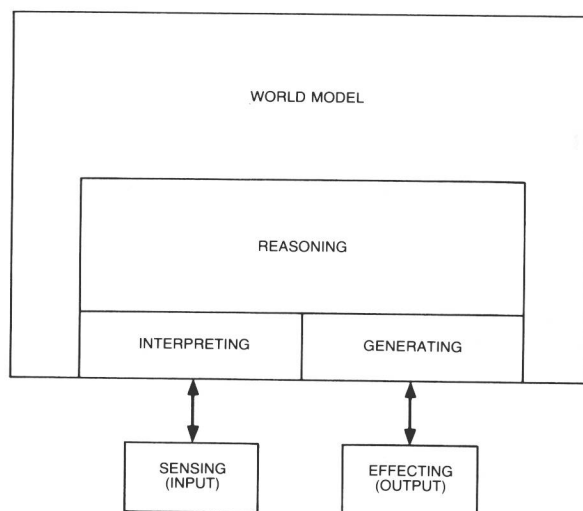


Fig. 1-2. A model of artificial intelligence and smart robots.