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Assistive Technology and Artificial Intelligence

Applications in Robotics, User Interfaces and Natural Language Processing

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Foreword

In the last decade, applications of Artificial Intelligence (AI) have become common and widespread. Reports in the series of conferences on the Innovative Applications of Artificial Intelligence, for example, document successful introduction of intelligent software for a rich variety of tasks within business, finance, science, medicine, engineering, manufacturing, education, the military, law, and the arts. Applications of AI have been demonstrated to save time and money, to increase throughput, to reduce errors, and to reach better decisions. However, relatively few applications address the important problems of enhancing the quality of life for people with disabilities.

The challenges associated with designing and constructing general-purpose assistive devices are great. But the current capabilities of many AI systems closely match some of the specialized needs of disabled people. For instance, rudimentary speech recognition for a limited vocabulary may be too limiting for general use in commercial applications, but it can be immensely useful to someone with severe physical limitations. Similarly with speech generation, text understanding, language generation, limited-task manipulators, vision systems, and so on. That is, even limited solutions to carefully circumscribed problems can make a difference.

Fortunately, there is a growing interest in applying the scientific knowledge and engineering experience developed by AI researchers to the domain of assistive technology and in investigating new methods and techniques that are required within the assistive technology domain. Some areas of current work include robotic wheelchairs, and the automation of the process of converting textbooks and other written materials into recordings for the blind. It also includes new user interfaces for computers to accommodate people with different kinds and varying degrees of motor, hearing, or visual disabilities. The same kinds of AI methods and principles that achieve flexibility in current applications should be applicable to tailoring devices for specialized needs.

The domain of developing better assistive devices is particularly interesting because the interaction between the person and the system allows researchers to overcome some of the common stumbling blocks for AI applications. It seems clear, for instance, that the users of these devices will be actively engaged in trying to make them work. They may also be inclined to accept some of the limits of new devices if the quality of help provided within those limits is significant. Many assistive applications need only solve a portion of the problem that would need to be solved for a fully intelligent assistant.

While the addition of a person into the cognitive loop allows researchers in this area to avoid some of the usual difficulties, it adds a new dimension that must be considered: the user interface. Researchers in this domain must consider the specialized needs of people with disabilities, often including interviews in the research process. Assistive applications with ineffective user interfaces will be

useless. Research in this area needs to build on past research on user interface technology, as well as AI, to come up with new solutions that can be tailored to the needs of specific individuals and adapt to changing needs.

Another important feature of this problem area is the cost-benefit equation. As in many medical problems, the cost of errors may be very high. Systems must be reliable when people use them in situations that are potentially dangerous, such as crossing the street. However, the benefits to those with severe disabilities are potentially as great as in any other application we can consider.

A substantial amount of AI research is clearly relevant to the applications considered here, for example, vision, locomotion, and manipulation systems for robots, planning systems, speech and text understanding and generation, decision making under uncertainty, troubleshooting systems, cognitive modeling, and intelligent interfaces. And more. But it needs careful engineering to be embedded in robust, portable, and cost-effective devices that are designed to be partners with people.

We are at a point in time when AI technology is advanced enough to make a significant difference in the lives of disabled people. The papers collected in this volume address many significant tasks and mention many more. They make it clear that researchers must understand what is needed by the disabled persons who will use the devices, as well as what is possible with the current AI technology. They also demonstrate that the benefits are not easily achieved. When the AI community is looking for meaningful challenges, these papers show us where to look.

Bruce G. Buchanan
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Preface

This volume arose out of a long standing interest that all of the editors have had in the use and advances of technology that can help people lead a better life. The focus here is on helping users extend their current range of cognitive, sensory or motor abilities. While some readers may associate the mention of a "wheelchair" with handicapped people, it should be emphasized that this category includes *all* of us. At some point or other in our lives, we can almost certainly benefit from technology that can help us hear, speak, understand or move about more easily. As we grow older, our physical faculties may diminish and we may *need* some of these assistive devices; but even if we are in perfect health, who amongst us would not like to have a car that could navigate around obstacles by itself, or have a real-time translator translate one language to another for us in a foreign country?

To that end, workshops and symposia were organized by one or more of the editors in Montreal in August 1995 (during the International Joint Conference on Artificial Intelligence), at the Massachussetts Institute of Technology in Boston (as part of the 1996 AAAI Fall Symposium Series) and in Madison, Wisconsin (during the 1998 National Conference on Artificial Intelligence). These workshops were informal affairs and led to extensive discussions, giving rise to several fruitful collaborations and fast friends.

One of the main points underscored by the workshops was that there was a significant amount of related work being conducted in many diverse fields such as robotics, vision, planning and natural language processing. However, there was little, if any, concerted effort to bring these researchers together. The workshops mentioned previously represented sporadic efforts to meet similar researchers and inform others about this work. It was felt that a collection of papers representing some of the work in related areas might help other researchers as well as prospective graduate students looking for dissertation topics. There is a unique aspect to working in this sub-area: a human is always part of the processing loop. This introduces certain constraints which can significantly change the nature of the problem being investigated. The collection of papers in this volume illustrates some of these issues well. We hope that these papers will spark users' interest in these and related issues and think how their own research might be used for addressing similar problems. We would like to thank all of our contributors and hope you find this compendium useful in your own research.

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