The Coming Robot Revolution

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Adi Marom, Graphic Artist

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Expectations and Fears About Emerging Intelligent, Humanlike Machines

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Preface

Making a robot that looks and behaves like a human being has been the subject of many popular science fiction movies and books. Although the development of such a robot faces many challenges, the making of a virtual human has long been potentially possible. With recent advances in various key technologies related to hardware and software, the making of humanlike robots is increasingly becoming an engineering reality.

Development of the required hardware that can perform humanlike functions in a lifelike manner has benefitted greatly from development in such technologies as biologically inspired materials, artificial intelligence, artificial vision, and many others. Producing a humanlike robot that makes body and facial expressions, communicates verbally using extensive vocabulary, and interprets speech with high accuracy is extremely complicated to engineer. Advances in voice recognition and speech synthesis are increasingly improving communication capabilities. In our daily life we encounter such innovations when we call the telephone operators of most companies today.

As robotics technology continues to improve we are approaching the point where, on seeing such a robot, we will respond with "Wow, this robot looks unbelievably real!" just like the reaction to an artificial flower. The accelerating pace of advances in related fields suggests that the emergence of humanlike robots that become part of our daily life seems to be imminent. These robots are expected to raise ethical concerns and may also raise many complex questions related to their interaction with humans.

This book covers the reality and the vision in the development and engineering of humanlike robots. The topic is described from various angles, including the state of the art, how these robots are made, their current and potential applications, and the challenges to the developers and users, as well as the concerns and ethical issues. This book includes discussion of the state-of-the-art trends, challenges, benefits, and plans for future developments. In the opening chapter, a distinction is made between humanoid robots that have the general appearance of humans and humanlike robots with an appearance that is identical to humans. Chapter 2 describes the currently available crop of humanoids and humanlike robots, while Chapter 3 examines various components that are involved in making such robots. The subjects of prosthetics, exoskeletons, and bipedal ambulators are covered in Chapter 4. Exoskeleton structures are used to augment the ability of humans in walking. Further, ambulators are chairs with two legs that carry humans and that are able to walk. They were developed to

replace wheelchairs for operation in certain difficult-to-maneuver areas, including climbing stairs while carrying a human.

Chapter 5 considers the issues that result from our making robots that mirror humans so closely. These robots challenge our human identity and our primacy as the lead species on the planet. Besides becoming household appliances these robots may significantly impact our lives and our economy; the potential impacts are discussed in Chapter 6. Once such robots become intelligent and perhaps even conscious, we will have to deal with certain ethical issues and others concerns that are expected to arise as described in Chapter 7. The book concludes with a chapter that describes and discusses the capabilities and challenges in developing the technology of humanlike robots.

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The photo, which is showing a robotic head and hand on the back cover of this book, was taken at JPL. The head was made by the coauthor, David Hanson, and the hand was provided to the principal author, Yoseph Bar-Cohen, as a courtesy of Graham Whiteley, Sheffield Hallam University, UK.

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About the Authors

Dr. Yoseph Bar-Cohen is a Senior Scientist and Group Supervisor at the Jet Propulsion Lab, NASA/Caltech, specializing in electroactive materials and devices as well as biomimetic mechanisms. Known best for his pivotal role in the development of artificial muscles, in 2003 *Business Week* entitled him as one of five technology gurus who are "pushing tech's boundaries." Dr. Bar-Cohen received his Ph.D. in physics (1979) from Israel's Hebrew University in Jerusalem. Some of his notable discoveries include the leaky Lamb waves (LLW) and the polar backscattering (PBS) phenomena in composite materials. He has (co)authored over 300 publications, made numerous presentations at national and international conferences, (co)chaired 37 conferences, has 19 registered patents, and is the (co)editor of 4 books. He was named a Fellow of the American Society for Nondestructive Testing (ASNT) in 1996 and of The International Society for Optical Engineering (SPIE) in 2002. Also, he is the recipient of two NASA Honor Award Medals – NASA Exceptional Engineering Achievement Medal (2001) and NASA Exceptional Technology Achievement (2006), plus two SPIE's Lifetime Achievement Awards as well as many other honors and awards.

Dr. David Hanson is an artist/scientist who creates realistic humanoid robots (a.k.a. androids), which are noted for being conversationally intelligent, energy efficient, and designed as novel works of character art/animation. In 2005, the low-power mobility of Hanson's robots was demonstrated in the world's first expressive walking humanoid, an Einstein portrait called "Albert Hubo," appearing on the cover of Wired magazine in January 2006. In addition to hardware innovations, Hanson and his company (Hanson Robotics Inc.) are known for developing increasingly intelligent conversational personas, integrating many forms of artificial intelligence (AI), including speech recognition software, natural language processing, computer vision, and Hanson's own AI systems to hold naturalistic conversations. Hanson has received awards in both art and engineering, including the Cooper Hewwit Triennial award, the National Science Foundation STTR award, and a TX Emerging Technologies Award. Hanson received a BFA from the Rhode Island School of Design in 1996, and his Ph.D. from the University of Texas at Dallas in 2007.

Adi Marom is a designer/artist with a broad international education and work experience. She specializes in the design of interactive kinetic applications. Her work integrates biomimetic technology, applying natural mechanism into deployable designs.

She holds a Masters of Design Engineering from The University of Tokyo, Japan; and a B.A. in Design from Bezalel Academy of Arts and Design, Israel. Currently, she is a scholar at NYU's Interactive Telecommunication Program (ITP). Marom experience consists of working for prominent design studios in Israel, Japan, and the United States. Her artwork has been displayed in exhibitions worldwide and has been featured in inernational media publications, including BoingBoing.net, TrendHunter.com, InventorSpot.com, Casa Brutus (Japan), DAMn° Magazine (Belgium), Joong Ang Daily (Korea), and TimeOut (Israel). This book is Marom's second collaboration with Dr. Yoseph Bar-Cohen. Previously, her designs have been featured in his book "Biomimetics: Biologically-Inspired Technologies", which was published by CRC Press in November 2005.