Chapter 11
Designing Useful Robots:
Is Neural Computation the Answer?

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ABSTRACT

This chapter explores the challenges presented by the introduction of robots into our everyday lives, examining technical and design issues as well as ethical and business issues. It also examines the process of designing and specifying useful robots and highlights the practical difficulties in testing and guaranteeing behaviour and function in adaptive systems. The chapter also briefly reviews the current state of robotics in Europe and the global robotic marketplace. It argues that it is essential, for the generation of a viable industry, for the Academic and Business sectors to work together to solve the fundamental technical and ethical problems that can potentially impede the development and deployment of autonomous robotic systems. It details the reality and expectations in healthcare robotics examining the demographics and deployment difficulties this domain will face. Finally it challenges the assumption that Neural Computation is the technology of choice for building autonomous cognitive systems and points out the difficulties inherent in using adaptive "holistic" systems within the performance oriented ethos of the product design engineer.

INTRODUCTION

The purpose of this chapter is not to describe new technologies or explore the state of the art, instead its aim is to highlight the challenges of designing useful robots. It will review some of the challenges that designers of useful robots will face in trying to make systems that can carry out real tasks in everyday environments. Its intention is to stimulate, with the hope that researchers will engage in exploring the means by which some of the fundamental issues in robotics might be addressed, not as bench top experiments in robotics but through the development of technologies that can be integrated into deployed, functional robotic systems.

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It is widely acknowledged that Robotics will be the next major electro-technical revolution. Unlike the computer revolution and the communications revolution, which we are still in the middle of, it is likely to take longer to establish itself. Firstly because the technologies are more complex and currently less well understood, and secondly because the pervasiveness of the technology will be much greater. The computer revolution has always been bounded by our ability to create faster processors and larger memories as characterised by Moore's Law (Moore, 1965) (Moore, 1975), the communications revolution is driven by standards and the creation of infrastructure, where technology has not limited its expansion in the same way it has limited the computer revolution. As might be expected Robotics has different constraints and drivers. In addition to technology and cost limitations, legal, societal and ethical issues will play a major role in the delivery and approval of many potential applications of robotics. There is no doubt that the robotics revolution has already started, but there is a long way to go before we will notice its impact and it will take several decades for the full impact to be felt. It will develop at a considerable pace but only once the technology is established and the service and delivery models have been refined. It is possible that Robotics will be the last great electro-technical revolution, and that its conclusion will mark the end of the era of electro-technical revolutions, at the conclusion of which the machine will be able to replicate the thoughts and intentional actions of humans. For this reason building useful robots is the ultimate engineering challenge.

This chapter will explore the design of robots and the potential for applications. It will also explore how they will impact on our daily lives possibly to a greater extent than any other technology ever has. Their pervasiveness in 50 years will surprise us but the Armageddon so loved by science fiction will not happen. They will alter our home and work lives, our transport and our healthcare. They will enrage, delight and the ethical, legal and societal issues will be a major cause of concern for government, parents and the children of the elderly.

There is also a sub-text to this chapter; it is to attempt to bring closer together the industrial and the academic, thus connecting the means of production with the research base. Only by working towards a mutual understanding of issues and by joining to solve common problems will the best outcome be achieved. In many cases across Europe there is a good working relationship between industry and academia, but what is required is a greater common understanding of how to effectively work together in a more open community that allows a greater transfer of technology to mutual benefit. The EU has recognised that this joining is particularly important in the field of robotics and is working to bring both groups together. This was no more clearly stated than at the launch of the Strategic Research Agenda for Robotics in Europe where Dr Rudolf Strohmeier (Head of Cabinet EU Commission for Information Society and Media) stated "Europe cannot afford the fragmentation of its research resource". Some of the larger manufacturing organisations within Europe are beginning to offer more open routes to design and to offer support for a freer flow of knowledge and resources and the move to Open Innovation practices will help.

EUROPEAN ROBOTICS

Europe has an extremely strong robotics industry founded on car manufacture and process automation. This has created global companies at the heart of Europe's robotics industry. While the industrial robotics community and the autonomous robotics community sometimes only see themselves as linked by the word robot, there is in fact a much deeper synergy that is possible. The development of the robotics market will take place across a broad spectrum of very different market sectors, and in many of these sectors real world sensing, object