Chapter 4
Practical Experimentation with Human Implants

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ABSTRACT

In this chapter, the authors report on several different types of human implants with which the authors have direct, first hand, experience. An indication is given of the experimentation actually carried out and the subsequent immediate consequences are discussed. The authors also consider likely uses and opportunities with the technology should it continue to develop along present lines and the likely social pressures to adopt it. Included in the chapter is a discussion of RFID implants, tracking with implants, deep brain stimulation, multi-electrode array neural implants, and magnetic implants. In each case, practical results are presented along with expectations and experiences.

INTRODUCTION

For many years, science fiction has looked to a future in which robots are intelligent and cyborgs – a human/machine merger – are commonplace. Movies such as *The Terminator*, *The Matrix*, *Blade Runner* and *I, Robot* are all good examples of this. But until recently, any serious consideration of what this future might actually mean was not necessary because it was largely considered science fiction and not scientific reality. Now, however, science has not only caught up but, in bringing about some of the ideas initially thrown up by science fiction, has introduced wild card practicalities that which extend further than the original story lines and even beyond current fiction.

It should be clear from the start that the authors of this paper are scientific experimenters who like to look outside the box. From a background of artificial intelligence, robotics and biomedicine, the authors have been an integral part of each of these experiments and the need for discussion and

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debate on the issues raised is recognised. The material here is presented with a view to contributing to the area in order to provide a concrete basis for what has actually been achieved and, hence, what might be possible in the future.

In each case an outline and explanation of the experimentation is given. Related academic papers are referenced, where appropriate, in order to provide more in-depth details.

Each experiment is described in its own self-contained section. Although there is clear technical overlap between the sections, they throw up individual considerations which the authors have not wished to blur. Following a description of each investigation, the authors have attempted to raise some pertinent issues on that topic. As can be seen, points have been raised with a view to near term technical advances and what these might mean in a practical scenario. This is not intended as an attempt to present a fully packaged, conclusive document. Rather, the aim is to open up the research carried out and its implications to ethical scrutiny and assessment.

RFID IMPLANTS

The first experiment to be considered is the use of implant technology, for example, the implantation of a Radio Frequency Identification Device (RFID) as a token of identity. In its simplest form, such a device transmits by radio a sequence of pulses which represent a unique number. The number can be pre-programmed to act rather like a PIN number on a credit card. So, with an implant of this type in place, when activated, the code can be checked by computer and the identity of the carrier specified.

Such implants have been used as a sort of fashion item, to gain access to night clubs in Barcelona and Rotterdam (The Baja Beach Club), as a high security device by the Mexican Government or as a medical information source (having been approved in 2004 by the U.S. Food and Drug Administration which regulates medical devices in the USA, see Graafstra, 2007; Foster & Jaeger, 2007). In the latter case, information on an individual's medication, for conditions such as diabetes, can be stored in the implant. Because it is implanted, the details cannot be forgotten, the record cannot be lost, and it will not be easily stolen.

An RFID implant does not have its own battery. It has a tiny antenna and microchip enclosed in a silicon or glass capsule. The antenna picks up power remotely when passed near to a larger coil of wire which carries an electric current. The power picked up by the antenna in the implant is employed to transmit by radio the particular signal encoded in the microchip. Because there is no battery, or any moving parts, the implant requires no maintenance whatsoever – once it has been implanted it can be left there.

The first such RFID implant to be put in place in a human occurred on 24 August 1998 in Reading, England. It measured 22 mm by 4 mm diameter. The body selected was the first author of this Chapter. The doctor involved burrowed a hole in the upper left arm, pushed the implant into the hole and closed the incision with a couple of stitches.

The main reason for selecting the upper left arm for the implant was that we were not sure how well it would work. We reasoned that, if the implant was not working, it could be waved around until a stronger signal was transmitted. It is interesting that most present day RFID implants in humans are located in a roughly similar place (the left arm or hand), even though they do not have to be. Even in the James Bond film, *Casino Royale* (the new version), Bond himself has an implant in his left arm.

The RFID implant allowed the author to control lights, open doors and be welcomed "Hello" when he entered the front door at Reading University (Warwick, 2000; Warwick & Gasson, 2006). Such an implant could be used in humans for a