ENGR 300 "Societal Issues in Engineering" David M. Rummler
Prof. Quinn 2/26/01

Technology Name: Medicine

Category: Internal Non-Biological Implants - Biomedical Engineering

Keywords: Prosthetics, Remote Surgery, Augmentation, Instrumentation, Artificial organs, Microsurgery

In today's society to become fully integrated with information, implanting a computer chip /processor internal to the human body doesn't seem that strange. Every day I carry a handheld palm pilot, which facilitates my management of information. What if I did not want to carry it anymore?….what if I don't see it as a separate thing anymore. Because of the advances in computing technology, the same computing power that once required an entire building to harness now can be inserted in your left arm.

Technology Background:
There have always been electronic medical devices available for people ever since the Civil War. People have been benefiting from pacemakers, artificial hearts, prosthetic limbs, hearing aids, and hormone producing implants such as Norplant. The history of human improvement goes back centuries. Prior to the 20th century, most improvement techniques involved discouraging unfavorable traits by preventing people with those traits from breeding and encouraging improvement of favorable traits through ensuring those with those traits bred together. In the 20th century selective breeding became discredited largely due to its associations with the German Nazi party and its master-race theories. However it became possible to isolate and manipulate the techniques of biological change outside of the control of sexual reproduction. However, recent breakthroughs in bioelectronics mean new technologies that may interface with the human nervous and other biological systems at a more basic level; nano technology causing changes in human biological structure that might be unprecedented.

Technology Description:
Within the medicine and biotechnology field, a specific focus for this technology analysis is the development and use of internal non-biological implants. Implants are internal enhancements. Most current implants are orthopedic replacements, such as an artificial bone in a hip or knee (metal, plastic or ceramic material), a tooth or root implant, or cosmetic implants (space filling grafts, breast implants). They fix an existing function, rather than add a new one. Implants can also modify the functions of the body - pacemakers, neuro-control functions, drug delivery devices (i.e.: Norplant – birth control) or add new functions. Only a few examples of implants currently add new functions, but we can imagine the eventual development of internal memory backups, artificial chromosomes, or encryption of DNA. While some of this technology remains the domain of science fiction, some of it is appearing here and now today, in the form of exoskeletons, artificial limbs and prostheses, biological implants, and electronic devices for restoring vision to the blind, the total artificial heart pursuit.

The computer, more so than any other device in history, is now making possible the augmentation of the human being. For the first time, through electronic technology, human biology is no longer destiny. Through prostheses, bio-implants, and biochips, electronic technology can be integrated into the human organism. This lends itself to new forms of human-computer interfaces (tele-operation, "electronic telepathy," etc.) are making possible human-machine interaction that rivals the most imaginative descriptions from science fiction. The question is, is it ethical for human beings to be doing this, should there be limitations on the integration of technology into human life, and what will the social consequences from all this be?

Microchips are now being implanted in animals and humans. Due to recent technological breakthroughs the size of microchips has more than significantly decreased while performance and uses have skyrocketed. These new machines, while a fraction of the size, have many more applications and are much more powerful. As newer technology continues to create more powerful and smaller chips the uses for them also change and multiply. Sophisticated chips are now available to identify living animals and humans. These chips are very small, about the size of a grain of rice, and are currently being used to identify the owners of lost or stray animals.

Recently, the first-ever working prototype was recently introduced to the public that combines biosensors and Web-enabled wireless telecommunications linked to Global Positioning System (GPS) satellite technology. The chip itself is a wafer-thin matchbox size device and is powered from heat generation. It is due for release in eight months and will cost between $100 and $300. While the designer and manufacturer suggest that lost pets could be found, human bodily functions such as blood sugar or heartbeat tracked online, or the health of livestock such as cattle monitored. Other such revelations, such as how it could be used to improve physical authenticity and security over the Net.

What happens when this technology is further expanded into humans? Some people are already experimenting with this even newer form of technology. There are many applications for microchips in humans. Not only is identification possible but there are also many medical uses for microchips in humans. These include cochlear and retinal implants, internal drug release, and even possible nerve centers for paralyzed persons. Some of these chips also have tracking capabilities, which could be used to find lost children, kidnapped victims, escaped convicts, and any other persons needing to be found. Some are even experimenting with the implanted chips to network themselves into their offices and computers. Others still believe that the human microchip implant will be the end of all currency. The chip could contain people's financial data, including bank account number and balances, stock holdings, and loan payments. The chip could also contain relevant medical information, including which medicines a person is allergic to, and medical history. It may even contain a living will in the case of a person being in a vegetative state and unable to make decisions.

Many groups are already concerned, or interested, with the uses of implants. These include various religious groups, several branches of the government, the medical field, the experimenters, and, of course, the public. The critics of bioelectronics and bio computing foresee numerous potential negative social consequences from the technology. One is that the human race will divide along the lines of biological haves and have-nots. People with enough money will be able to augment their personal attributes as they see fit (which is what they already do with techniques such as spas, plastic surgery, etc.) as well as to utilize cloning, organ replacement, etc. to stave off death for as long as they wish, while the majority of humanity will continue to suffer from plague, hunger, 'bad genes,' and infirmity. It's hard not to see the biological 'haves' advocating separation and/or extinction inevitably for their unmodified peers.

Several ethical issues arise, such as the violation of rights, or the fundamental issues of what it means to be human. The integration of biological and electronic processes suggests that they may be very similar in their mode of operation, and only based on different physical constituents. Most people assume that they have attributes machines do not (free will, emotions, a soul) but will these beliefs hold up, as electronic technology becomes 'hardwired' into human organisms? The idea that human beings are worth something regardless of their deficits, flaws, and infirmities, maybe lost in the onrush to human biotechnological improvement

Human biotechnology could be an inevitable necessity based on coming changes. Human genetic structure may be irreversibly altered for the worse as levels of radiation, chemical pollution, and so on continue to increase. Global climate is likely to change drastically due to global warming and ozone depletion. People maybe forced by overpopulation and overcrowding into parts of the world previously hostile to human settlement, whether in deserts, underground, under the sea, or perhaps even other planets. And then there are always the periodic extinctions on our planet, which many scientists now think may be due to regular collisions with asteroids or the reversal of the magnetic field. These global changes may be irreversible and the only way for the human race to avoid perishing as a species is to make some rapid technological changes in its biological adaptability.

Legal Implications of the use of implant to monitor and track individuals are raised. It's logical to suspect that one of the other dangers inherent in bioelectronics might be the ability to control and monitor people. It would be easy to utilize bio-implants that would allow people to trace the location and perhaps even monitor the condition and behavior of implanted persons. This would be a tremendous violation of human privacy, but the creators of human biotech might see it as necessary to keep their subjects under control. Once implanted with bio-implant electronic devices, humans might become highly dependent on the creators of these devices for their repair, recharge, and maintenance. It could be possible to modify the person technologically so that their body would stop producing some essential substance for survival, thus placing them under the absolute control of the designers of the technology.

As many scientists have eloquently argued, once a technology is out there, you cannot make it go away. The genie simply will not go back in the bottle. There never was a technology that the human race ever abandoned wholesale, even the hydrogen bomb or other weapons of mass destruction with the power to wipe out all life on Earth. You might eventually be able to ban the production of H-bombs, but it would take a long time to kill everybody who knew how to make one or eliminate all blueprints and specifications for the design. Thus, once invented, bioelectronics technologies cannot be wished away.

In order for bioelectronic research to progress, it will have to accept that the potential dangers are real, and that the concerns of some skeptics are valid. Otherwise, something disastrous might occur which might create a "black –area" perception for the industry, much as has happened with nuclear power in the U.S., and nothing positive will ever have been attained. Too much regulation and oversight will only hinder research in this area and prevent scientific progress in the relevant areas. This technology should be evaluated on the following criteria: 1. Safety, 2. Privacy, 3. Ease of implementation, 4. Cost of implementation, 5. Rate of public acceptance.

Once given the opportunity to improve themselves in any form, human beings rarely surrender the opportunity, whether it's "pumping iron" or exercise to raise physical fitness, so-called "smart drugs" to raise intelligence, or vitamin therapies to stem the onslaught of the aging process. When human beings are offered the chance to utilize computers and electronic technologies within their bodies to achieve these same results, it is almost certain they will embrace them regardless of the risks. Based on this, it would be unrealistic to try and ban such technologies, however one might worry about their ethical and social consequences. A ban would only probably force them into a large, criminal black market, as illegal drugs and weapons already have been. While it cannot be possible to foresee all the consequences resulting from bioelectronics, most scientists are already aware of what some of the major dangers are. Researchers in biocomputing may be required to adopt protocols on acceptable research with human subjects, much as genetic engineers did back in the 1970s. In drafting bioethical imperatives for bioelectronics research, it will probably be imperative to consider the concerns of groups such as the religious community, since to ignore their concerns simply out of the insistence that they are merely acting out of "anti-science" ignorance will leave an important group "out of the loop" of this research. Society must assert that the scientists and engineers charged with creating this new technology exert the proper amount of social responsibility. Safeguards will have to be insisted on to prevent the possible negative impacts discussed above, and many of these things will have to be built in at the instrumental level, since they probably cannot be achieved only through policy and regulation. Critical public awareness and vigilance will be essential. Which touch on aspects of human existence and human nature which reach to the core of what most people think is involved in what it means to be human.

Some current examples of how might this technology might evolve are as follows.
First, a tiny microchip composed of organic and synthetic materials is now available for implanting into the body of any person who is concerned about being kidnapped. The "Sky-Eye" chip, an adaptation of Global Positioning Network technology developed by Israeli intelligence researchers, is being marketed by Gen-Etics, a company based in Milan, Italy that has patented the device for private use.

Second, consumer-level implant technology this sophisticated suggests that military intelligence versions of the same or better technology may have been in use for many years. Those who see the potential of a sort of master race from this technology. Certainly, the military has already considered the possibility of the super-soldier, augmented by technology so that he has faster reflexes, deadlier accuracy, greater resistance to fatigue, integrated weaponry, and most importantly, lesser inclinations toward fear or doubt in combat.