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Tele-operation through brain waves

The concept of implants to tap and use neural signals to control external devices was pioneered by Prof. Kevin Warwick. This was demonstrated in his Project Cyborg1 where he implanted a chip into his own forearm. The concept was stretched further (Project Cyborg 2) to include using external signals to generate neural stimuli. This (Project Cyborg 2) has a close relation with incorporating higher sensations such as touch, taste and smell into **virtual reality systems** making the immersion more realistic. Electrical signals can be sent to the brain through such devices thus simulating touch without actually having to physically provide the pressure, heat, etc. inputs that would otherwise be required. It's like fooling the brain into thinking that the body is touching something. Important applications have been derived for this technology. An example is a system that allows the blind to navigate around obstacles. An ultrasonic transmitter sends out waves that bounce off obstacles and are received by a receiver. The receiver transmits the information about the existence of the obstacle to the brain of the user by neural signals through implants. This is a type of virtual reality system where no display is required to simulate vision.

Project Cyborg 1

What happens when a man is merged with a computer?

This is the question that Professor Kevin Warwick and his team at the the department of Cybernetics, University of Reading intend to answer with 'Project Cyborg'.

On Monday 24th August 1998, at 4:00pm, Professor Kevin Warwick underwent an operation to surgically implant a silicon chip transponder in his foream. Dr. George Boulous carried out the operation at Tilehurst Surgery, using local anaesthetic only.

This experiment allowed a computer to monitor Kevin Warwick as he moved through halls and offices of the Department of

Cybernetics at the University of Reading, using a unique identifying signal emitted by the implanted chip. He could operate doors, lights, heaters and other computers without lifting a finger.

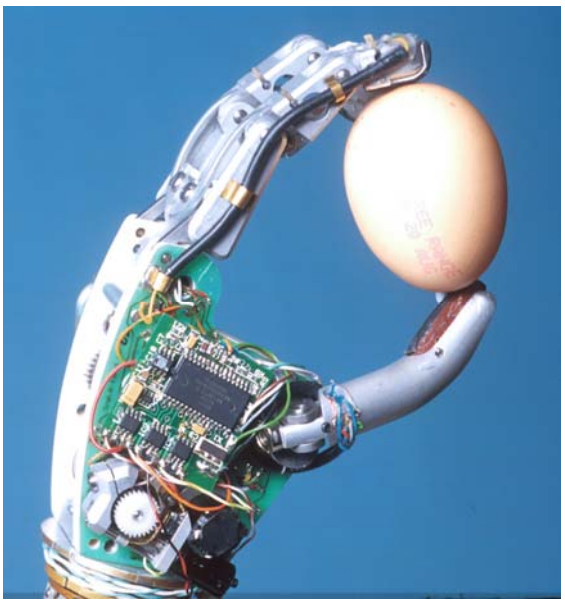
The chip implant technology has the capability to impact our lives in ways that have been previously thought possible in only sci-fi movies. The implant could carry all sorts of information about a person, from Access and Visa details to your National Insurance number, blood type, medical records etc., with the data being updated where necessary.

The second phase of the experiment Project Cyborg 2.0 got underway in March 2002. This phase will look at how a new implant could send signals back and forth between Warwick's nervous system and a computer. If this phase succeeds with no complications, a similar chip will be implanted in his wife, Irena. This will allow the investigation of how movement, thought or emotion signals could be transmitted from one person to the other, possibly via the Internet. The question is how much can the brain process and adapt to unfamiliar information coming in through the nerve branches? Will the brain accept the information? Will it try to stop it or be able to cope? Professor Kevin Warwicks answer to these questions is quite simply "We don't have an idea - yet, but if this experiment has the possiblility to help even one person, it is worth doing just to see what might happen".

Project Cyborg 2

The next step towards true Cyborgs?

On the 14th of March 2002 a one hundred electrode array was surgically implanted into the median nerve fibres of the left arm of Professor Kevin Warwick. The operation was carried out at Radcliffe Infirmary, Oxford, by a medical team headed by the neurosurgeons Amjad Shad and Peter teddy. The procedure, which took a little over two hours, involved inserting a guiding tube into a two inch incision made above the wrist, inserting the microelectrode array into this tube and firing it into the median nerve fibres below the elbow joint.

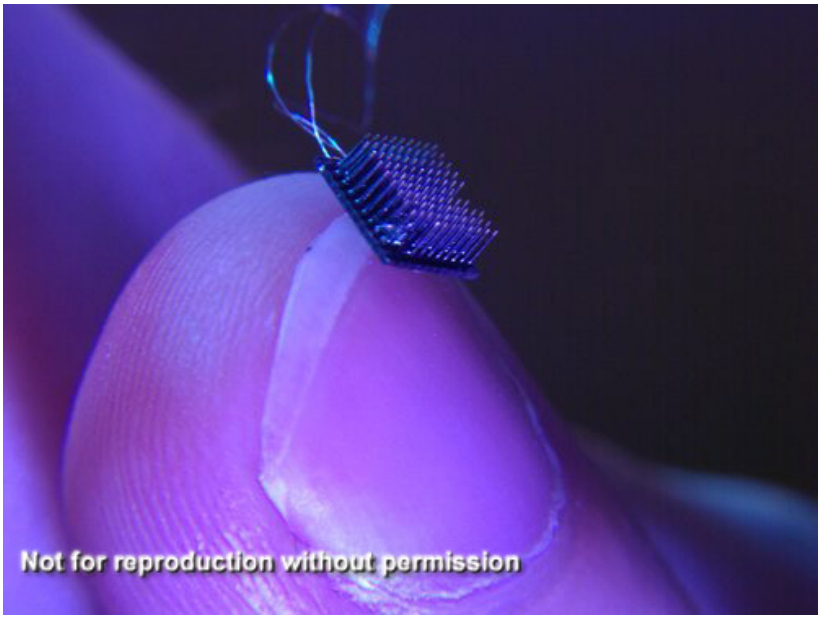


A number of experiments have been carried out using the signals detected by the array, most notably Professor Warwick was able to control an electric wheelchair and an intelligent artificial hand, developed by Dr

Peter Kyberd, using this neural interface. In addition to being able to measure the nerve signals transmitted down Professor Wariwck's left arm, the implant was also able to create artificial sensation by stimluating individual electrodes within the array. This was demonstrated with the aid of Kevin's wife Irena and a second, less complex implantconnecting to her nervous system.

Another important aspect of the work undertaken as part of this project has been to monitor the effects of the implant on Professor Warwick's hand functions. This was carried out by Allesio Murgia a research student at the department, using the Southampton Hand Assessment Procedure (SHAP) test. By testing hand functionality during the course of the project the difference between the performance indicators before, during and after the implant was present in Kevin's arm can be used to give a measure of the risks associated with this and future cyborg experiments.

The Neural Interface



The interface to Professor Warwick's nervous system was a micro electrode array consisting of 100 individual electrodes implanted in the median nerve of the left arm. A 25-channel neural signal amplifier amplifies the signals from each electrode by a factor of 5000 and filters signals with corner frequencies of 250Hz and 7.5KHz. The amplified and finltered electrode signals are then delivered to the neural signal processor where they are digitized at 30,000 samples/second/electrode and scanned online for neural spike events. This means that only 25 of the total 100 channels can be viewed at any one time.

Neural spike events are detected by comparing the instantaneous electrode signal to level thresholhds set for each data channel. When a supra-threshold event occurs, the signal window surrounding the event is time stamped and stored for later, offline analysis. The neural stimulator allows for any of the 25 monitored channels to be electrically stimulated with a chosen repetition frequency at any one time.

The BBC on Prof. Kevin Warwick :

Kevin Warwick: Saviour of humankind?

Crazed scientist or gifted visionary? The jury is still out on wannabe cyborg Kevin Warwick, who gives this year's Royal Institution Christmas lectures. By Chris Jones of the BBC's News Profiles Unit.

He has been called "a buffoon" and "a media tart". But Professor Kevin Warwick insists he is engaged in a noble mission: to save humankind.

The ire of several academics has been well and truly aroused by the news that Warwick, Professor of Cybernetics at Reading University, is to deliver the prestigious Royal Institution Christmas lectures, following in the footsteps of the distinguished physicist and chemist Michael Faraday, who delivered the inaugural lectures in 1825.

Warwick is the man who has declared: "I want to do something with my life; I want to be a cyborg."

In 1998, he had his first experience of being a cybernetic organism, part human and part machine, when he had a silicon chip transponder surgically implanted in his arm, enabling him to operate doors and lights automatically and be greeted with a "Hello" from the building's computer.


Warwick had a transceiver implanted in 1998

Operation

Although other academics wondered about the value of the demonstration, the 46-year-old professor is planning to have another implant inserted in 2001 which should establish contact between a computer and his nervous system.

And if there are no complications, Kevin Warwick's wife, Irena, 52, will have a similar hour-long operation at Stoke Mandeville hospital, the world-renowned centre for spinal injuries.

Then, for two weeks, the £250,000 implant should enable the couple to transfer their physical feelings to each other - even when they are thousands of kilometres apart.

They intend to subject themselves to their phobias - Kevin is afraid of heights while Irena is scared of spiders - to find whether they experience each other's fear.

If the physical experiment works, Warwick will try to record the signals relating to emotions and play them back, raising the possibility of reliving sexual arousal or feeling tipsy.

> **I want to be a cyborg**
>
> **Professor Kevin Warwick**

But, bearing in mind that Stoke Mandeville Hospital is footing the bill for the surgery, there are other, perhaps more worthy, implications.

Collaboration

Professor Warwick's department has previously collaborated with the hospital on helping people overcome disabilities through technical aids; and it is hoped the experiment could eventually enable amputees to feel limb sensations again, or allow blind people to navigate around objects with ultrasonic radar, much as bats do.

Some of Warwick's previous experiments have encountered problems, though. A robot arm was unable to hold a teacup, while a robot called Roger attempted to follow the sun rather than a transmitter, and retired hurt from a half-marathon after crashing into a kerb.

But Warwick maintains that his work is necessary to tackle problems that threaten the viability of the human race.

He asserts that before the century is out, intelligent machines will effectively take over from humans: "Just as we treat creatures less intelligent than ourselves now, so we'll see machines treating us, perhaps having humans in farms, humans in zoos and if we're lucky, human pets."

Warwick: Future belongs to cyborgs

In future...humans may be in zoos

Professor Kevin Warwick

Youthful academic

And Kevin Warwick contends that a possible way for humans to escape this grim future is to evolve as cyborgs.

Professor Warwick left school at 16 and spent six years with British Telecom before embarking on an academic career in which he acquired a doctorate from Imperial College, London, and held posts at Oxford, Newcastle and Warwick universities before being offered the Chair at Reading at the age of 32.

He has made no attempt to discard his Coventry accent or his working-class origins and even some of his critics acknowledge he is charming and accommodating.

But that has done little to dispel the anger over his Royal Institution honour among Artificial Intelligence experts. Dr Inman Harvey of Sussex University, called Professor Warwick a "buffoon".

Controversy

And another expert at Sussex, Blay Whitby, is anxious to stress that Warwick's views are "highly untypical". "Most people in the field feel he's providing false expectations and false fears," he says.

"The majority believe robots are nowhere near ruling a filing cabinet, let alone the world.

"I can understand why a professor should be seeking publicity to get funds, but we'd do better to worry about bacteria, which evolution has selected to attack us, or daisies, which are programmed to take over the world."

Professor Susan Greenfield, the director of the Royal Institution, has expressed her "whole-hearted support" for Kevin Warwick, but outside the academic cloisters of the scientific world, even the most assertive have confessed themselves unqualified to judge.

Could robots become a comnmon sight on the streets?