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Rise of the robo-brain: Tiny flexible electronics are injected into the brains of mice to mesh with cells

- Flexible electronics can be injected into brain tissue through a needle
- Mesh of electrodes unfold when in position to 30 times width of the needle
- Tests showed they were not rejected in mice and revealed brain activity
- Could one day be used to monitor human brains or hearts

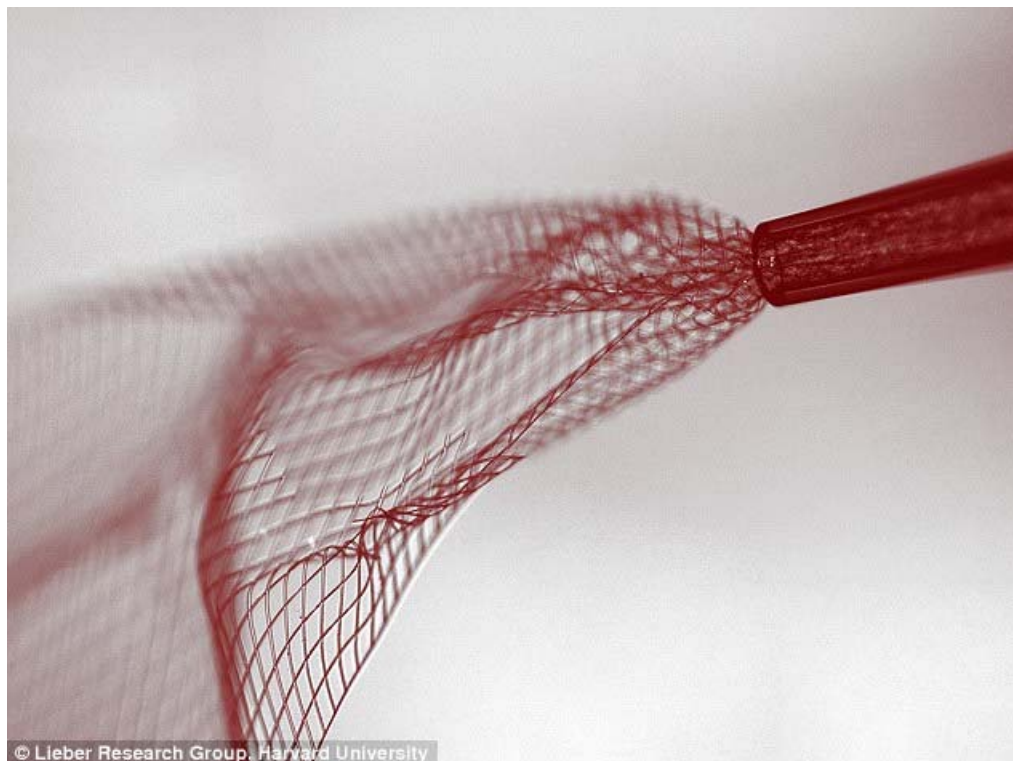
By [Sarah Griffiths for MailOnline](#)

Published: 10:45 EST, 8 June 2015 | Updated: 10:48 EST, 8 June 2015

From mind-control to boosting intelligence, brain implants are a popular feature of sci-fi films.

Now scientists have engineered flexible electronics that can be injected into brain tissue through a needle to mesh with biological brain cells.

This mesh of electrodes can unfold once in position and has so far been used to monitor brain activity in mice - suggesting it may be capable of similar feats in humans one day.



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Scientists have engineered a flexible electronic mesh (pictured) that can be injected into brain tissue through a needle to merge with biological brain cells

Previous research has shown that electronics can be surgically implanted but this is the first time that electronics have been implanted in tissues non-invasively.

'We have introduced a new strategy for delivering electronics to the internal regions of 3D man-made and biological structures that involves the syringe injection of submicrometre-thickness, large-area macroporous mesh electronics,' the researchers wrote.

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The mesh-shaped electronics were injected via a needle with a diameter of just 0.1 millimetres, according to the study published in the journal Nature Nanotechnology.

They unfolded to their original shape in less than an hour with widths more than 30 times that of the needle once they were injected into two distinct brain regions in live mice.

The electronics retained approximately 80 per cent of their original configuration with no loss of function.



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The mesh-shaped electronics were injected via a needle with a diameter of just 0.1 millimetres (pictured). They can unfold once in position and have so far been used to monitor brain activity in mice – suggesting they may be capable of similar feats in humans one day

THE SOCIAL NETWORK THAT LETS YOU LIVE FOREVER

People could soon live forever by uploading their personalities, memories and mannerisms into a computer.

Martine Rothblatt, founder of United Therapeutics, believes this could happen within this century, and has created an online service to make it a reality.

Called Lifenaut, the service offers a series of personality tests and combines this with data from social media profiles to create accurate digital avatars.

Eventually, the team say these avatars can be transformed into walking robots that interact with others – and it's now offering a basic version of its service for free.

The technology echoes an episode of Black Mirror, a British television series, in which a woman's husband dies, and she replaces him with a robot.

'Taking a mind and offloading it to software is consistent with physics, and it's something that I think will be done in this century,' said Rothblatt, during an interview at [eMerge Americas](#).

The team from Harvard University and the National Centre for Nanoscience and Technology in Beijing, found the mesh produced no immune response over a period of five weeks and were able to network with healthy neurons.

But more excitingly still, when the electronics were injected into the the hippocampus of the mice, the scientists found that they could monitor the animals' brain activity with limited damage to the surrounding brain tissues.

The experts behind this innovation said flexible and stretchable electronics could be used to continually monitor tissues, such as the workings of the brain or heart.

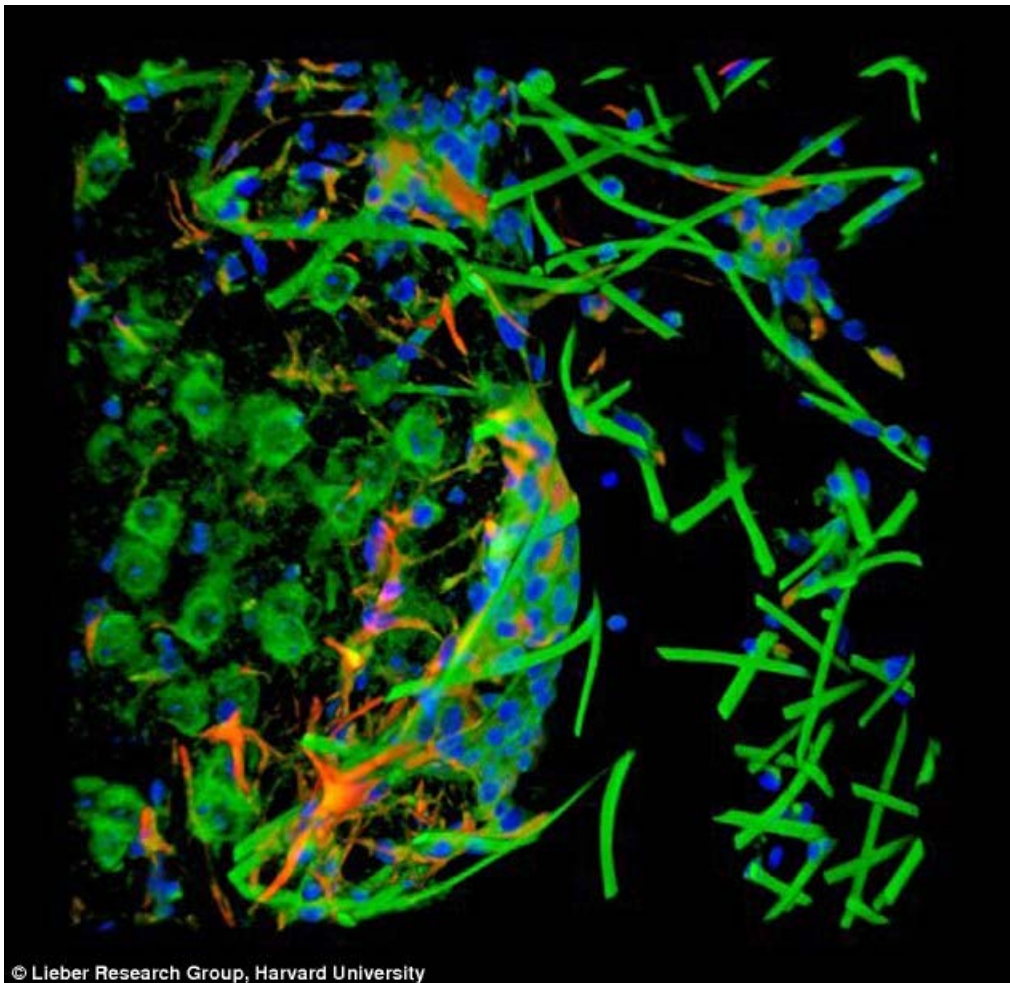
In the near future, the research could be extended to implant multifunctional or wireless devices into mice.

In the longer term, the innovation could even be used to make a human bionic brain, by co-injecting mesh electronics 'with cells into host systems for unique engineering and biomedical applications,' the study said.

It has previously been claimed that in just 30 years, humans will be able to upload their minds to computers to become digitally immortal - an event called singularity.

Ray Kurzweil, director of engineering at Google said in 2013 that it will also be possible to replace body parts with mechanical devices and that this could happen by the end of the century.

He said: 'Based on conservative estimates of the amount of computation you need to functionally simulate a human brain, we'll be able to expand the scope of our intelligence a billion-fold.'



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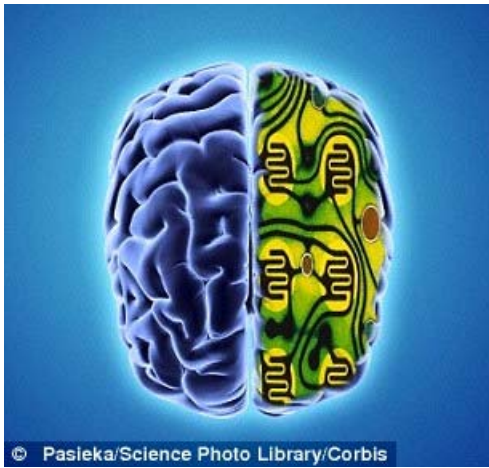
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The team found the mesh produced no immune response over a period of five weeks and electronics were able to network with healthy neurons. This image shows stimulation of the neural tissue, as well as the migration of neural progenitor cells on to the mesh within the cavity

He referred to Moore's Law that states the power of computing doubles, on average, every two years quoting the developments from genetic sequencing and 3D printing.

In Mr Kurweil's book, *The Singularity Is Near*, he plots this development and journey towards singularity in a graph.

This singularity is also referred to as digital immortality because brains and a person's intelligence will be digitally stored forever, even after they die.



It has previously been claimed that in 30 years humans will be able to upload their minds and replace body parts with mechanical parts, illustrated

He added that this will be possible through neural engineering and referenced the recent strides made towards modeling the brain and technologies which can replace biological functions.

Examples of such technology include the cochlear implant - an implant attached to the brain's cochlear nerve and electronically stimulates it to restore hearing to someone who is deaf.

Other examples include technology that can restore motor skills after the nervous system is damaged.

Expanding on this idea Martine Rothblatt, chief executive of biotech company United Therapeutics introduced the idea of 'mindclones'.

These are digital versions of humans that can live forever and can create 'mindfiles' that are a place to store aspects of our personalities.

She said it would run on a kind of software for consciousness and told [The Huffington Post](#): 'The first company that develops mindware will have [as much success as] a thousand Googles.'

Rothblatt added that the presence of mindware could lead to replacing other parts of the body with 'non-biological' parts.

This is a concept that Mr Kurzweil also discussed and was the basis of his book *Fantastic Voyage*.

In this book he discussed immortality and how he believes the human body will develop.

He said: 'We're going to become increasingly non-biological to the point where the non-biological part dominates and the biological part is not important any more.'



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Ray Kurzweil, director of engineering at Google (pictured) said in 2013 that it will also be possible to replace body parts with mechanical devices and that this could happen by the end of the century

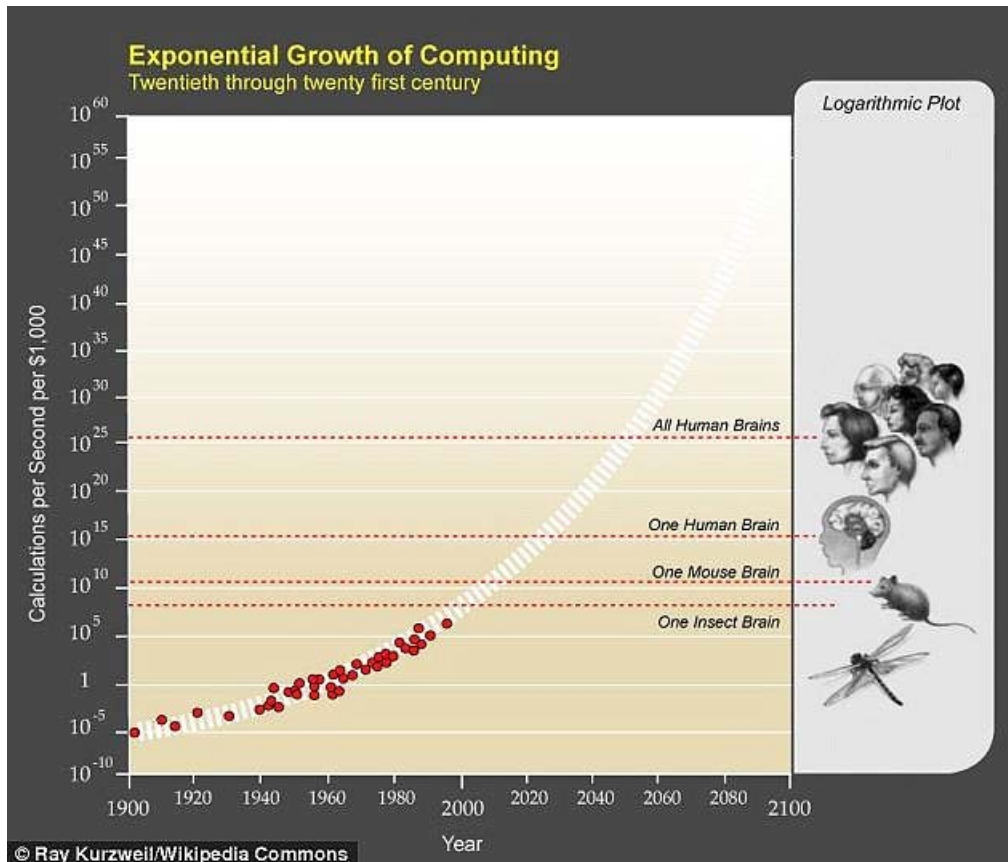
'In fact the non-biological part - the machine part - will be so powerful it can completely model and understand the biological part. So even if that biological part went away it wouldn't make any difference.

'We'll also have non-biological bodies - we can create bodies with nano technology, we can create virtual bodies and virtual reality in which the virtual reality will be as realistic as the actual reality.

'The virtual bodies will be as detailed and convincing as real bodies.

'We do need a body, our intelligence is directed towards a body but it doesn't have to be this frail, biological body that is subject to all kinds of failure modes.

'But I think we'll have a choice of bodies, we'll certainly be routinely changing our parent body through virtual reality and today you can have a different body in something like Second Life, but it's just a picture on the screen.



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In his book, *The Singularity Is Near*, Mr Kurzweil refers to Moore's Law of Computing, (pictured). The law claims the power of computing doubles, on average, every two years which puts us on course for singularity by 2045

'Research has shown that people actually begin to subjectively identify with their avatar.

'But in the future it's not going to be a little picture in a virtual environment you're looking at. It will feel like this is your body and you're in that environment and your body is the virtual body and it can be as realistic as real reality.'

As well as this, he said we will have a 'radical life expansion.

Kurweil explained: 'We're going to have million of virtual environments to explore that we're going to literally expand our brains - right now we only have 300 million patterns organised in a grand hierarchy that we create ourselves.

'But we could make that 300 billion or 300 trillion. The last time we expanded it with the frontal cortex we created language and art and science. Just think of the qualitative leaps we can't even imagine today when we expand our near cortex again.'

Read more:

- ['Mind Uploading' & Digital Immortality May Be Reality By 2045, Futurists Say](#)
- [Martine Rothblatt, Ph.D., MBA, J.D. :: eMerge Americas 2015 WIT Speaker](#)



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[oseph](#), Ottawa , Canada, 9 minutes ago
mice always get the short end of the stick?

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[Andersen](#), Bondi, Australia, 23 minutes ago
the merger of human and machine intelligence will be the turning point for our species because it will unify human knowledge and consciousness with the capacity and speed to share information which is already inherent in computer technology. It is this merging which is likely going to be the key to our evolution during the course of this century and probably in ways that we would currently be completely unable to comprehend. It has been described as ˆthe end point of our current culture, when the ever-accelerating evolution of technology finally overtakes us and changes everythingˆ. The risk is that nobody can foresee with certainty what the final outcome would be. Personally I view this development as being akin to trying me explain the inner workings of the internet to my pet Dobermann, in other words totally incomprehensible from the point where we are now. The merging of humans and machines will not happen overnight but it will occur incrementally in small steps.

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[St. Anthony](#), 23 minutes ago
s one problem, however. In the recent years, it has been scientifically shown that "Moore's Law" is not as applicable today as it was in the past. As a man who grew up in the "computer Renaissance," yes indeed it was effective. There was a time when every three months, computer speeds would double thanks to advances in miniaturization, etc. We, as a society ,however, have started to "peak" out of this. That's why all modern processors have multiple cores. Speeds can't be increased like they used to be, so now technology manufacturers are building in robust and real multiprocessing as opposed to the old multi-threading. Honestly, this guy seems a little bit over optimistic to me. Can it happen int he future? Possibly. Soon? Very doubtful. Remember, the science of the brain is still based in a lot of theory. We STILL don't know how exactly the brain works. That should be figured out 100% before we start tampering with them. That's my opinion anyway.

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[py](#), The Rainy Part, United States, about 3 hours ago
e they doing this research with Ch ina? Are they that stupid? Gullible?

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[e86](#), IrvineCA, United States, about 4 hours ago
plants will one day be standard, whether it's a disaster or a wonderful addition is yet to be determined.

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[1](#), Burlington, United States, about 4 hours ago
rdized Injection at Birth

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[lthe2nd](#), Monticello, United States, about 7 hours ago
ant wait for my Big Brother mindcontrol implant so we can all be slaves to the state.

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| <div> edford, United Kingdom, a day ago</div> <p>ice? Would have got the same results from Rooney.</p> | | | | |
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| <div> Sister, N-A, France, a day ago</div> <p>r are they going with this as that sounds truly horrible.</p> | | | | |
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| <div> HReally, SomewhereinUSSA, United States, about 6 hours ago</div> <p>I have a funny feeling it is going to be forced upon us.</p> | | | | |
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