INNOVATION NEWS

TOP 25 INNOVATIONS of the past 25 years

1. The Internet
2. Cellphones
3. Personal computers
4. Fibre optics
5. E-mail
6. Commercialised Global Positioning Systems (GPSs)
7. Portable computers
8. Memory storage discs (e.g. CDs)
9. Consumer level digital cameras
10. Radio frequency ID tags
11. MEMS (Micro-electromechanical systems)
12. DNA fingerprinting
13. Air bags
14. ATMs (Automatic Teller Machines)
15. Advanced batteries
16. Hybrid cars
17. Organic Light Emitting Diodes (OLEDs)
18. Display panels (e.g. Plasma screens)
19. HDTV (High-definition TV)
20. Space shuttle
21. Nanotechnology
22. Flash memory
23. Voice mail
24. Modern hearing aids
25. Short Range, High Frequency Radio (Wi-Fi)

Ratings performed by a panel of technology leaders assembled by the Lemelson-MIT Program, which promotes inventiveness among teenagers.

TOP 25 technology breakthroughs of the past 25 years

1. Wireless world
2. Defence technology
3. Alternative fuel vehicles
4. Biotechnology
5. Computers
6. Lasers
7. Genomics
8. Global finance
9. Processors
10. Digital storage
11. Space
12. Fibre optics
13. Satellite TV & radio
14. DNA testing
15. Video games
16. Biometrics
17. Energy and water savers
18. Scanning tunnelling microscopes
19. Batteries
20. E-baggage
21. Remote controls
22. Animal cloning
23. Manufacturing technology
24. The big picture (e.g. Plasma TV, HDTV and IMAX)
25. Weather technology

Ratings performed by CNN

IN BRIEF:

Honda has developed the world's first intelligent night–vision system for cars. Two infrared cameras assess whether heat-emitting objects up to 80 m away are pedestrians. The system then calculates the chance of a collision and warns the driver. The system is already available in Japan.

A system to spot potentially dangerous debris on runways is to be installed at Heathrow Airport. It uses high–resolution radar to detect objects as small as suitcase wheels or metal nuts up to 2,000m away.

A new audio surveillance system could help fight crime in the city and protect kilometres of unmanned boarders. Software developed by Ted Berger, Director of the University of Southern California Centre for Neural Engineering, can be trained to recognise and distinguish sounds that are indicators of a security breach or a safety hazard, such as a gunshot or the rattle of someone climbing chain-link fence. The software is based on mathematical models that mimic the way the brain interprets sound, but it can distinguish between two similar sounds far more precisely than the human ear.

Mounted on streetlight poles, the devices listen for sounds like gunshots, and then guide surveillance cameras toward the source of the sound. Berger says the technology can also be used for large-scale security; an array of detectors placed along a deserted border, for example, could listen for footfalls or whispers, painting a scene solely on the basis of acoustic information. The detectors could then notify a central location of any suspicious activity.

BY THE NUMBERS

	China	Chile	Germany	USA	South Africa
Genetically modified crops (hectares)	3.7m	Unknown	Unknown	47.6m	0.5m
Average cost per 20 hours of Internet use (US$)	10.14	21.81	14.10	14.95	33.33
High-tech exports (% of manufactured exports)	23	3.2	16.6	32	3.2
Information and communication technology (ICT) spending per capita (US$)	58	246	1,252	2,358	225
Internet users per 1,000 people	46	238	412	551	68
Cellphones per 1,000 people	161	428	727	488	304

Sources: *International Service for the Acquisition of Agri-Biotech Applications, World Bank.*

HOT OR NOT?

When your core body temperature gets out of whack – even one degree outside the normal range – it could be a sign of medical distress. But getting an accurate reading usually requires a rectal probe. Oregon USA medical technology firm Mini Mitter has a less intrusive device: a pill-sized, ingestible thermometer called Jonah that transmits data wirelessly to a handheld unit.
http://www.minimitter.com/

MICRO TRACKER

Tiny radio frequency identification (RFID) chips can enable the tracking of everything from pets to batches of razor blades. But their need for antennas to transmit data has held up efforts to shrink them. Now Hitachi has embedded an internal antenna in an RFID chip the size of a fleck of ground pepper using standard semi-conductor manufacturing techniques. Special readers provide power to activate the chips and can scan identification numbers from a distance of about a millimetre. Because of the short communication distance, the new chips are not suited for product tracking, but they could be used to authenticate documents such as bank notes, passports and gift certificates.

MILESTONES

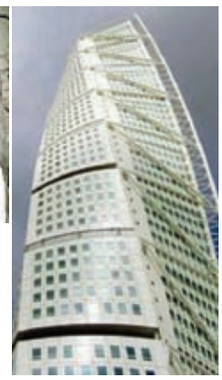
Insects such as water striders can walk on water – and new robots can too. Mettin Sitti, an engineering professor who heads Carnegie Mellon University's Nano–Robotics Lab, has built an eight–legged mechanical creature that's so light — about one gram — that it can stand on water and propel itself forward without breaking the water's surface. Equipped with tiny sensors, Sitti, says, future water-striding robots could also be used to monitor water quality or snoop on enemies.

SETBACK

Longhorn, Microsoft's successor to the Windows XP operating system, won't be ready for launch until late-2006. That's more than a year later than originally projected, implying that rival operating systems such as Linux will have more time to get footholds before Microsoft upgrades its flagship product.

SKY-HIGH

Santiago Calatrava's latest masterpiece, the Turning Torso high-riser, was completed in December 2005 in Malmö, Sweden, making it Europe's tallest residential skyscraper and Scandinavia's tallest building. This building represents a growing architectural movement toward mixed-use towers that promote activities 24 hours a day. The radical Turning Torso, with its improbably slender diameter of about 35 metres, comprises of nine cubes—twisting 90 degrees from bottom to top—which rise 54 stories (about 190 metres) topped with a glass-enclosed floor for meetings and special events, and features a rooftop observation deck with vistas across the Øresund strait.
http://www.arcspace.com/architects/calatrava/torso/



→ The Turning Torso residential tower is meant to be seen as a freestanding sculptural element inspired by the human body, as shown in this sketch by architect/civil engineer Santiago Calatrava. (Pictures by arcspace)

50 YEARS AGO:

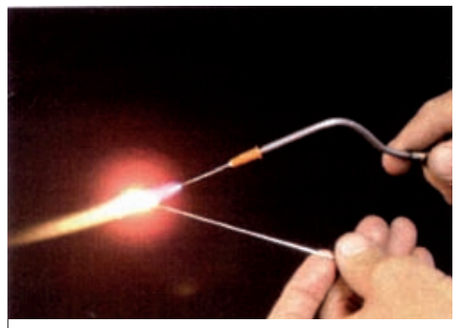
South African, Trevor Wadley develops the tellurometer, the first microwave distance-measuring equipment in the world. It is used primarily for measuring distances in land surveying.

35 YEARS AGO:

Professor Alan Cormack, a University of Cape Town researcher, develops the technology for the CAT-scanner. This invention made it possible to take three–dimensional X-rays in order to find diseased tissue in the human body. His theoretical research was used by Godfrey Hounsfield to make a practical machine that could be used in hospitals. Cormack and Hounsfield were awarded the 1979 Nobel Prize for Physiology and Medicine, for the "development of computer assisted tomography."

10 YEARS AGO:

The Natal Sharks Board designs the SharkPOD protective oceanic device, a successful shark repellent used by scuba divers worldwide.



HOT STUFF

The Hydrox Combo welder promises great benefits for the DIY home operator, jewellers, dental technicians, and for anyone interested in the welding profession. This innovative product is used with a DC welding inverter to perform fine gas welding operations, using the electrolysis of water to produce hydrogen and oxygen as fuel.

This compact welding system was designed and developed by Jan Brand, a mechanical instrument maker in the Department of Mechanical and Aeronautical Engineering at the University of Pretoria. His beautifully engineered system uses standard 220-volt mains outlets to power a mini reactor, which employs high-power MOSFET technology. This unique welder uses hypodermic needle sized nozzles that create small, precision flames with welding temperatures of 3300°C. The system is commercially available at the sale price of a single-purpose welding machine. The Hydrox Combo was awarded the Invention of the Year award by Popular Mechanics magazine.

Further information:
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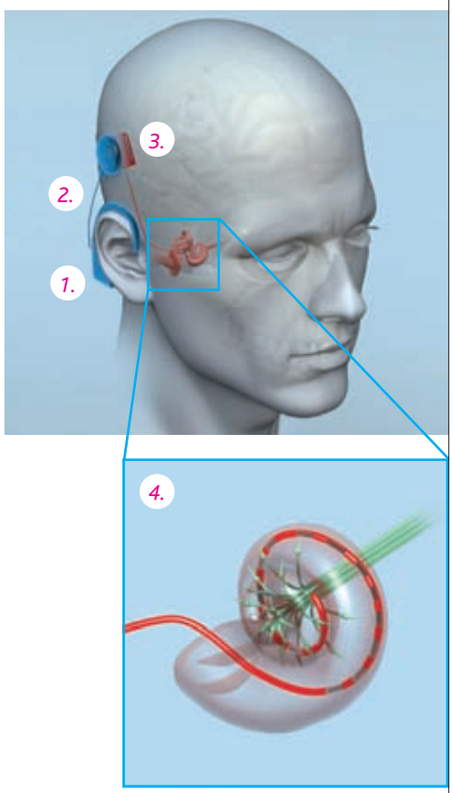
EYE SPY

Suretha Viljoen of the Bioengineering Group in the University of Pretoria's Department of Electrical, Electronic and Computer Engineering, developed an eye-controlled computer mouse. Detection of voluntary eye blinks is established by the reflection of infrared light from the skin on the side of the eye, while involuntary eye blinks are ignored. This enables people who do not have the use of their limbs to operate a computer. All the functions of a standard PS2 mouse are emulated, which means that the eye blink mouse can be plugged into any PS2 compatible computer and does not require any additional software.

RESTORING SOUND

Cochlear implants, introduced 20 years ago, have given an estimated 83,000 deaf people worldwide the ability to hear human speech. Surgeons drill a hole in the skull, embed a sound receiver, and weave an electrode array in the cochlea (near the auditory nerves). Once the hardware is in place, software engineers take over, upgrading the devices as needed so users can enjoy more complex sounds, like music.



Bryan Christie Design

1. The earpiece contains a microphone to receive sound and a processor to convert it to digital information.

2. The information travels up to a headpiece that uses a radio transmitter to relay the digitised sound through the skin.

3. The sound is picked up by an implant in the user's scull. The headpiece clings magnetically to the implant through the scalp.

4. The implant coverts the radio signal into electrical impulses, which travel to an array of 16 or 24 electrodes in the inner ear. The electrodes strobe on and off to stimulate the auditory nerves. In time, the user learns to interpret the signal as sound.

5. Users upgrade their hearing by downloading software to the external processor. Early implant users heard just eight channels (compared to 3000 for normal hearing). The latest software makes 121 channels possible.

Bioengineering is an interdisciplinary engineering application field that applies engineering tools and principles to solve problems in the medical and biological domains. The cochlear implant is by far the most successful bioengineering product ever. This is a device that stimulates the auditory system of a deaf individual electrically to elicit a sound sensation. The implanted part of a cochlear implant is an array of electrodes that is inserted in the cochlea during surgery. The outer part consists of a microphone and a speech processor that transforms and encodes the sound signal. The encoded sound is transmitted to the implanted electrodes by a radio signal. The electrodes then electrically stimulate nerve fibres in the cochlea to elicit a sensation of sound.

Tens of thousands of profoundly deaf people worldwide (over 200 in South Africa), have regained some hearing by using cochlear implants. These are people that could not benefit from hearing aids, but have now regained the ability to use the telephone.

From the clinical viewpoint, cochlear implants are safe, reliable, and provide adequate sound information to deaf people. Despite being so successful, cochlear implant systems do not sound like normal hearing. Some users describe the sound as being similar to a radio that is tuned off the station. Not all users perform equally well and some users derive very little benefit due to poor quality of sound. Even the best implant listeners have difficulty in following speech in noisy conditions, and most implant users do not like the sound of music.

Ideally, cochlear implants must emulate normal hearing. Most of the current research on cochlear implants worldwide revolves around the problem of how to achieve a quantum leap in sound quality. This is where the work of the Bioengineering group at the University of Pretoria fits in. The husband and wife team of Prof. Johan Hanekom and Dr Tania Hanekom does research that aims to improve understanding of the relationship between the design of the cochlear implant and the perceived sound.

Despite the success of cochlear implants from a clinical viewpoint, this relationship is not well understood. Research at the University of Pretoria includes computer modelling of cochlear implants and psychoacoustic experimental work. One of the valuable contributions is a very flexible model of the implanted cochlea. This model is used to explore the influence of different designs and placement of cochlear implant electrodes in targeting the stimulation of specific regions of nerve fibres. This in turn aids understanding of how changes to different aspects of the cochlear implant design may result in improved sound quality.

STRENGTH TO THE LIVER

Bio-artificial liver support brings new hope

→ The BALSS bio-reactor has living hepatocyte (liver) cells attached to a three-dimensional matrix. The hepatocyte cells are kept alive and healthy by using artificial oxygen carrier (perfluorocarbon or PFC) and close monitoring and control of system parameters.

The chronic shortage of donor livers means that those that suffer liver failure have only one chance in five of surviving. But research at the University of Pretoria, South Africa, is giving new hope to those afflicted with acute hepatic failure (AHF). An artificial liver support system is being designed to give patients the time they desperately need to either find a new liver, or regenerate their own organ.

The Bio-Artificial Liver Support System (BALSS) acts much like an external artificial heart-lung bypass machine, taking over the critical functions of a liver, including synthesis, metabolic activities, detoxification and excretion. The patient's own blood plasma is passed through the BALSS, and returned to the patient's body after being processed through living liver cells in the machine.

The BALSS project spans multiple scientific fields – a meeting of advanced engineering and medicine. Currently the project is being led by Dr Schalk van der Merwe of the Department of Internal Medicine, Kobus van Wyk of the Department of Mechanical and Aeronautical Engineering and Dr Sean Moolman of the Materials Science and Manufacturing Operating Unit (M&Mtek) division of the Council for Scientific and Industrial Research (CSIR).

Van Wyk undertook the system layout and design while Moolman developed the perfluorocarbon (PFC) oxygen carrier. Van der Merwe oversees all clinical aspects of the project. The prototype BALSS system is undergoing animal trials to evaluate its efficacy.

Initially funding of the project was provided by the University of Pretoria and South African parastatal research organisation, the CSIR. A further R6.9 million has been provided for three years by the Department of Trade and Industry's Innovations Fund.