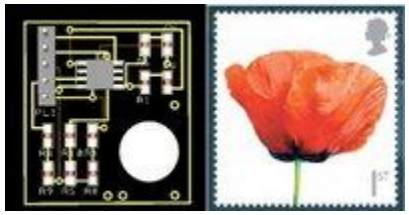
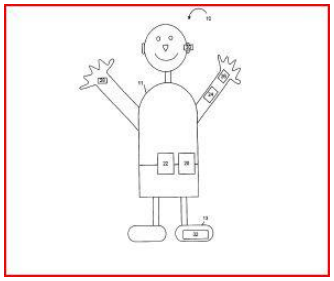
Sense and Sendability – Novel Mobile Devices for the Future





- Oxford **ICT Forum Conference**
- 14 July 2011
- Lyndsay Williams, Girton Labs, Cambridge UK

WARNING

High Power, Colour Laser: This laser outputs 5mW of light in the 405 nanometer wavelength which produces a blue color

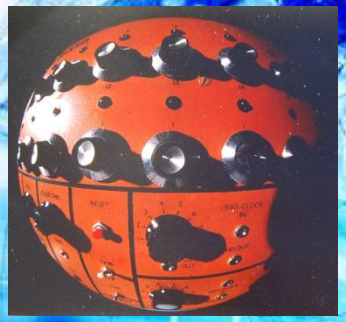
- This is a handheld laser pointer that exceeds 1 mW of power (United Kingdom). Due to laws and regulations in these countries, this type of item is prohibited from purchase in the United Kingdom.

Sense and Sendability - Novel Mobile Devices for the Future

- In an era of sophisticated smartphones and mobile computing it is worth noting that novel technologies can still begin in a dream and by tinkering in the garage. This presentation will review some key ideas being used in today's smartest devices, how they emerged and were developed, as well as where some of these and more recent ideas might take us in future devices. From the use of accelerometers, touch controls, GPS and cameras to interact with smartphones, to the potential for hand-tracking interfaces and gesture control without cameras, to touch-sensitive waterproof sticky note paper alarms and potential successors to the mouse, the future of mobile (and other) computing devices will include far more sophisticated input and interactions which could help us live better and plan for a more sustainable world.

Introduction

- Girton Labs Ltd, Cambridge was founded by Lyndsay Williams in 2007.
- Williams has degree in BioMedical Electronics Hons from the University of Salford, UK, and is a Computer Scientist in the field of Human Computer Interaction (HCI)
- HCI Designs for BT Research Labs, Martlesham, Microsoft Research, (Sensecam) Apple Inc (iPhone)
- specialises in embedded digital and analogue microcontroller systems, 3D multi-touch computer surfaces, digital audio , sensors, and GSM wireless sensors.
- Won 4 EEDA/TSB Grants for Research and Development, 2008,2009 for computers for Alzheimer's patients



William's History

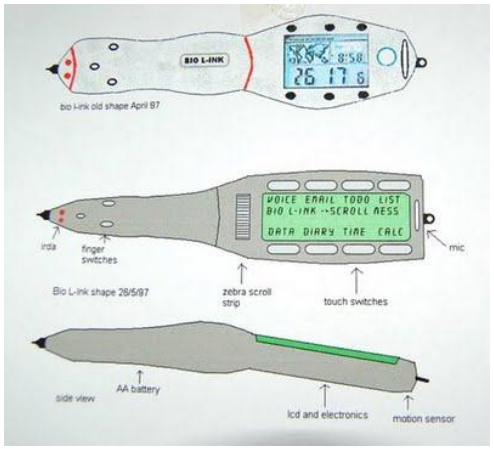
- Design of digital audio soundcards for PC's in 1980's for Commodore, (1984) Datel, (1982), Amstrad, Philips (1988) etc
- Senior Research Fellow BT Labs Martlesham 1997-1998

  Hardware Researcher for Microsoft Research 1998-2007, 16 patents filed

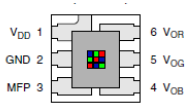
  Currently Part Time Consulting Expert for Apple Inc on iPhone Patent 2008

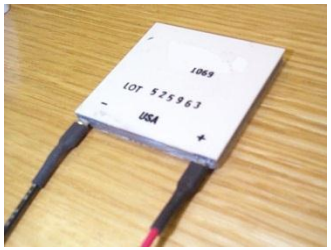
  2011-2011 Part Time Senior Research Fellow, Central St Martins , London, sensing computers

  MD of Girton Labs Ltd, Cambridge, sensing computers



Sensors,actuators





BT patent 12 July 2011

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12 July 2011 Last updated at 02:37

475 Share

Apple files patent complaint against phone maker HTC

Apple has accused the smartphone maker HTC of infringing its patents, in the latest phase of the legal battle between phone and tablet PC makers.

Apple has filed a complaint against the US International Trade Commission (ITC) seeking an inquiry by the panel into the matter.

The news comes just weeks after Apple and Samsung accused each other of copying designs and technology.

HTC is the world's third-biggest mobile phone maker, by stock market value.

Sales of HTC's smartphones have surged making it a big player in the industry

However, HTC has denied Apple's allegations.

"HTC is dismayed that Apple has resorted to competition in the courts rather than the market place," said Grace Lei, HTC's general counsel.

Growing rivalry

The launch of products like iPhone and iPad saw Apple become the market leader in the smartphone and tablet PC market.

Apple's success in quickly securing a large slice of the market, with fashionable products enjoying good demand from consumers, prompted several rivals to launch their own gadgets hoping to win a share of the fast-growing market.

However, that resulted in relations between Apple and its rivals souring as the competition grew.

Last year the American technology company filed a similar complaint against HTC accusing it of infringing as many as 20 of its patents.

That prompted HTC to launch a counter attack, claiming that Apple was guilty of infringing patents held by the Taiwanese company.

HTC went to the extent of seeking a ban on sales of iPhones, iPads and iPods in the United States.

Related Stories

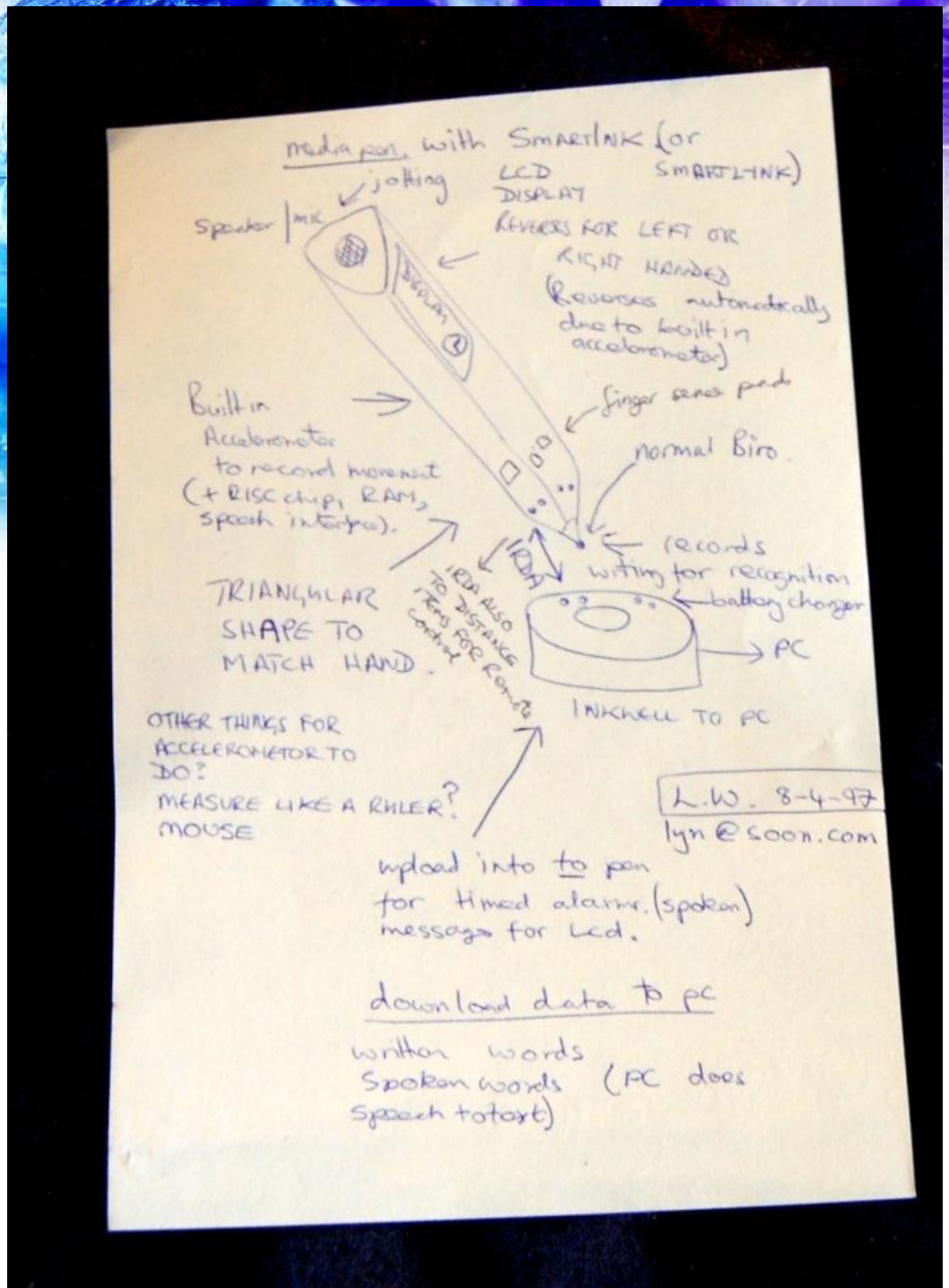
Samsung seeks US Apple sale ban

HTC leads Asia race to beat Apple

(List acquired from Foss Patents blog)

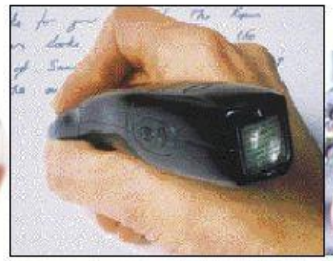
Apple claims that five patents are being violated by the list of devices mentioned above. Here's the list:

- U.S. Patent No. 7,844,915 on "application programming interfaces for scrolling operations" (Apple is asserting this one against Samsung in a federal lawsuit)
- U.S. Patent No. 7,469,381 on "list scrolling and document translation, scaling, and rotation on a touch-screen display" (Apple asserts this one in its federal lawsuit against Samsung and, very importantly, in its motion for a preliminary injunction)
- U.S. Patent No. 7,084,859 on "programmable tactile touch screen displays and man-machine interfaces for improved vehicle instrumentation and telematics" (not previously asserted)
- U.S. Patent No. 7,920,129 on a "double-sided touch-sensitive panel with shield and drive combined layer" (asserted against Samsung in Apple's first amended complaint in its federal lawsuit)
- U.S. Patent No. 6,956,564 on "portable computers" (not previously asserted; Apple acquired this one from British Telecom in 2008)

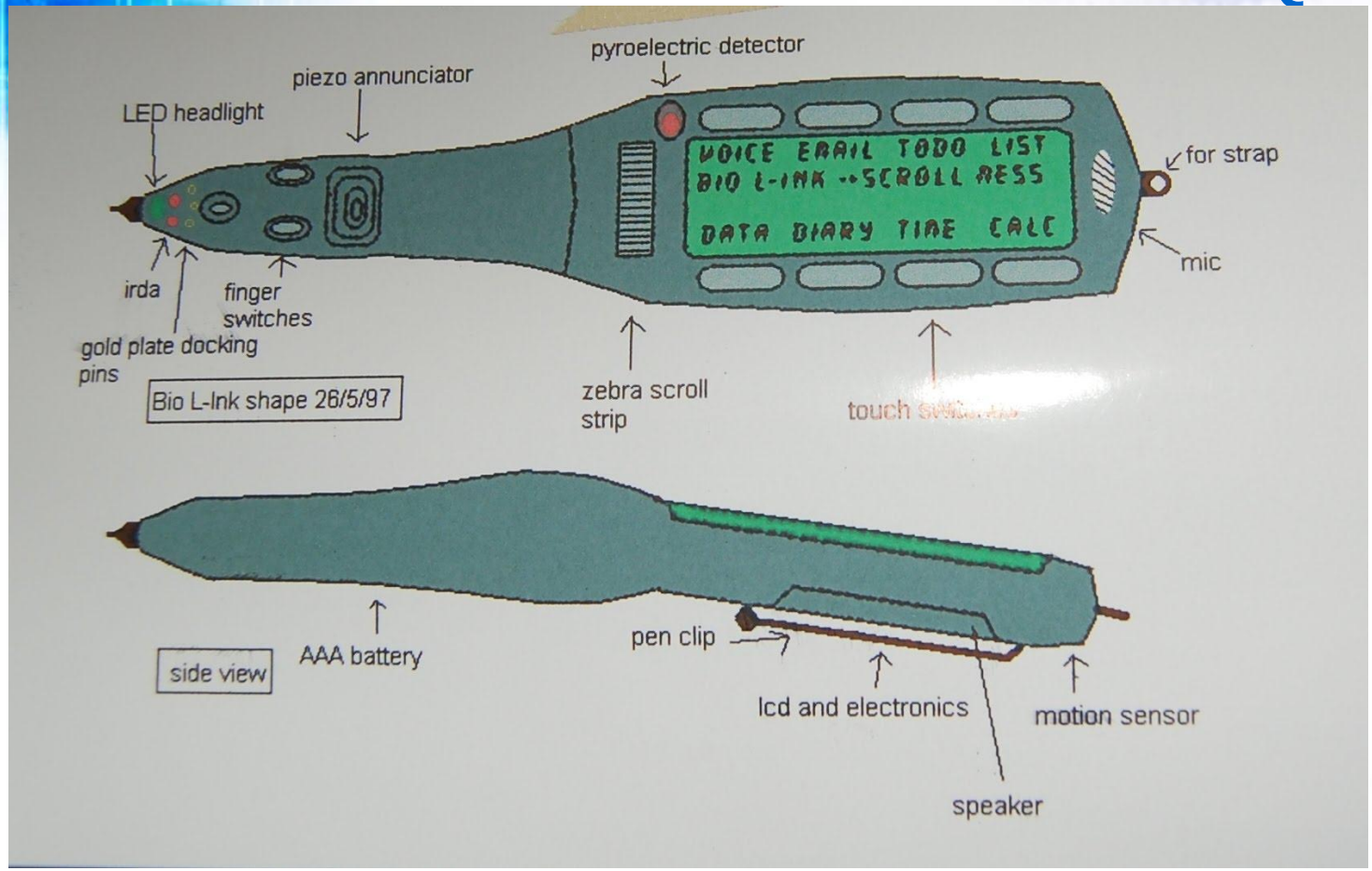


SmartQuill
April 1997





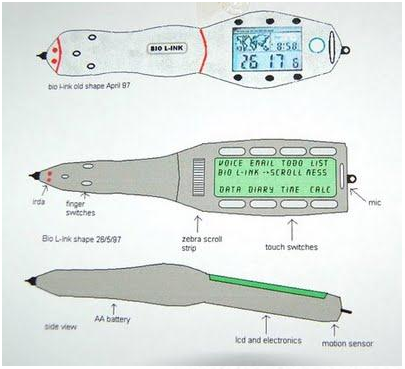

SmartQuill



SmartQuill

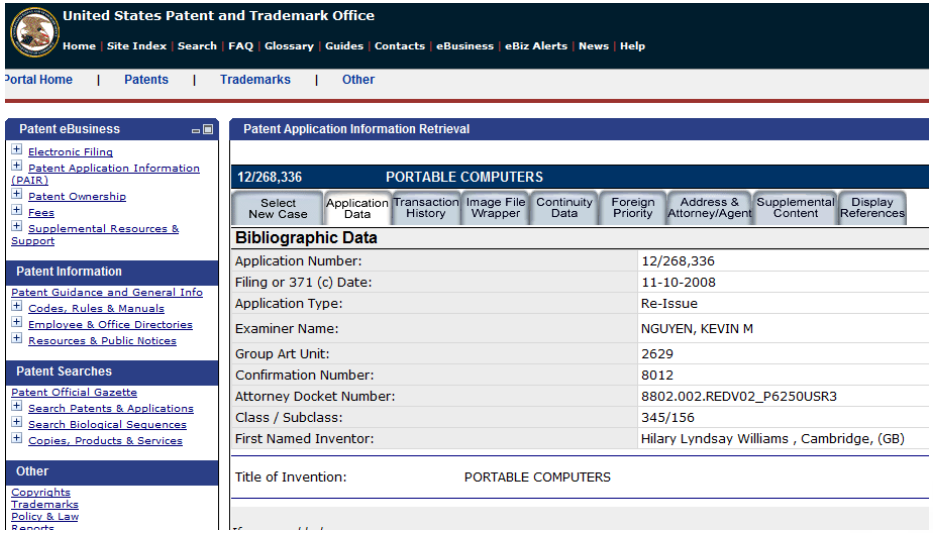
- Design of a computer without a keyboard
- Using motion sensor, heat sensing, touch strip for phone invented by Williams in 1997
- Sale of Williams' BT patent for mobile phone with sensors, i.e. Accelerometers ,in 2007,
- Part Time Consulting Expert for Apple Inc on iPhone patent, 2008- current

6,956,564, Re. S.N. 12/255,557, Oct. 21, 2008, Cl. 345/000, PORTABLE COMPUTERS, Hilary Lyndsay Williams, Owner of Record: APPLE INC., Attorney or Agent: Tracy W. Druce, Ex. Gp.: 1661



Apple bought patent ‘564

- 2800+ pages in public domain re lawyers working on patent ‘564 at USA patent office.



13th July 2011

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News

HTC share price hit by latest Apple patent infringement claim

Warwick Ashford
Wednesday 13 July 2011 10:10

Smartphone maker HTC's shares have fallen for two consecutive days after Apple accused the company of infringing Apple patents.

The case may even halt US imports of the Taiwanese company's phones and its new Flyer tablet computers, according to Bloomberg.

Shares fell 6.9% in immediate reaction to news of Apple's patent case and then a further 5.9% the following day to the lowest levels since January.

The company's legal representatives said HTC continues to deny all of Apple's past and present claims against it and will continue to protect and defend its own intellectual property.

HTC has also told Apple, which is also suing Samsung for allegedly copying Apple product designs, that it should aim to compete instead of resorting to legal action, according to other reports.

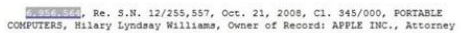
HTC's general counsel, Grace Lei, said the company is tired of Apple constantly suing every other smartphone manufacturer and should seek to compete in the market.

SmartQuill Timeline

April 1997

LW worked for BT May 1997- 98

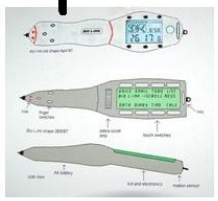
LW went to work for Microsoft



Apple bought Patent '564

Apple /HTC issue patent '564 12 July 2011

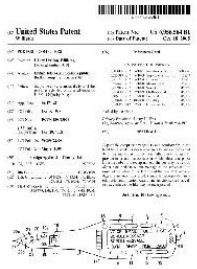
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011



April 1997

BT filed patent '564 in Oct 1998

patent awarded to BT



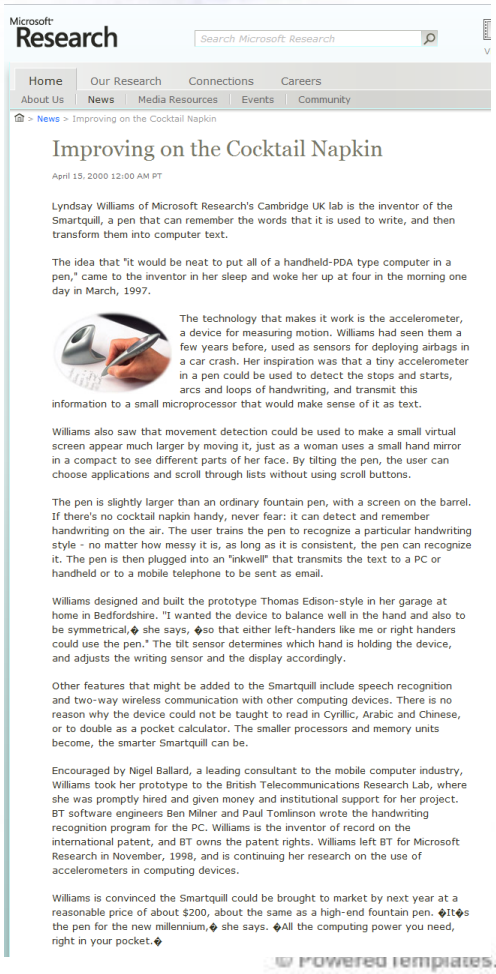
iPhone released

Apple awarded Patent 23 May 2011

Apple/ LW work on reissue of patent 2008-2011

Microsoft 1998-2007

- Left BT in 1998, went to work for Microsoft
- Microsoft slightly interested in SmartQuill but didn't
- buy patent, was "underwhelmed" by it.
- (Apple bought it in 2008)
- Why would a phone have sensors like accelerometers
- , face detection, (heat) detect screen orientation
- and no keyboard? Why put a camera in a phone or GPS?
- So needed to invent something else.



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Improving on the Cocktail Napkin

April 15, 2000 12:00 AM PT

Lyndsay Williams of Microsoft Research's Cambridge UK lab is the inventor of the Smartquill, a pen that can remember the words that it is used to write, and then transform them into computer text.

The idea that "it would be neat to put all of a handheld-PDA type computer in a pen," came to the inventor in her sleep and woke her up at four in the morning one day in March, 1997.

The technology that makes it work is the accelerometer, a device for measuring motion. Williams had seen them a few years before, used as sensors for deploying airbags in a car crash. Her inspiration was that a tiny accelerometer in a pen could be used to detect the stops and starts, arcs and loops of handwriting, and transmit this information to a small microprocessor that would make sense of it as text.

Williams also saw that movement detection could be used to make a small virtual screen appear much larger by moving it, just as a woman uses a small hand mirror in a compact to see different parts of her face. By tilting the pen, the user can choose applications and scroll through lists without using scroll buttons.

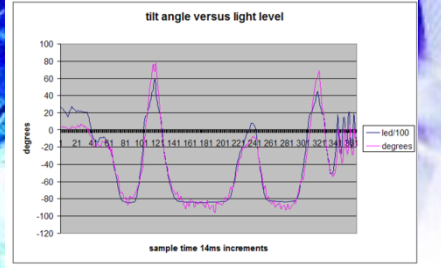
The pen is slightly larger than an ordinary fountain pen, with a screen on the barrel. If there's no cocktail napkin handy, never fear: it can detect and remember handwriting on the air. The user trains the pen to recognize a particular handwriting style - no matter how messy it is, as long as it is consistent, the pen can recognize it. The pen is then plugged into an "inkwell" that transmits the text to a PC or handheld or to a mobile telephone to be sent as email.

Williams designed and built the prototype Thomas Edison-style in her garage at home in Bedfordshire. "I wanted the device to balance well in the hand and also to be symmetrical,&#65533; she says, &#65533;so that either left-handers like me or right handers could use the pen." The tilt sensor determines which hand is holding the device, and adjusts the writing sensor and the display accordingly.

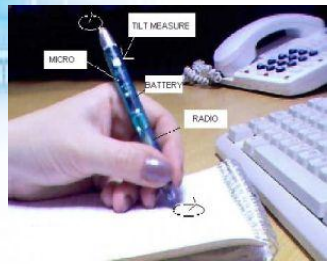
Other features that might be added to the Smartquill include speech recognition and two-way wireless communication with other computing devices. There is no reason why the device could not be taught to read in Cyrillic, Arabic and Chinese, or to double as a pocket calculator. The smaller processors and memory units become, the smarter Smartquill can be.

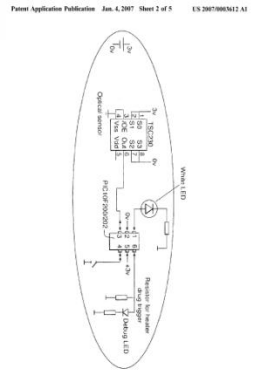
Encouraged by Nigel Ballard, a leading consultant to the mobile computer industry, Williams took her prototype to the British Telecommunications Research Lab, where she was promptly hired and given money and institutional support for her project. BT software engineers Ben Milner and Paul Tomlinson wrote the handwriting recognition program for the PC. Williams is the inventor of record on the international patent, and BT owns the patent rights. Williams left BT for Microsoft Research in November, 1998, and is continuing her research on the use of accelerometers in computing devices.

Williams is convinced the Smartquill could be brought to market by next year at a reasonable price of about $200, about the same as a high-end fountain pen. &#65533;It&#65533;s the pen for the new millennium,&#65533; she says. &#65533;All the computing power you need, right in your pocket.&#65533;



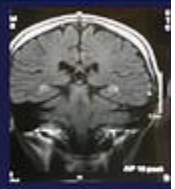
Williams - Microsoft Research Cambridge 1998-2007



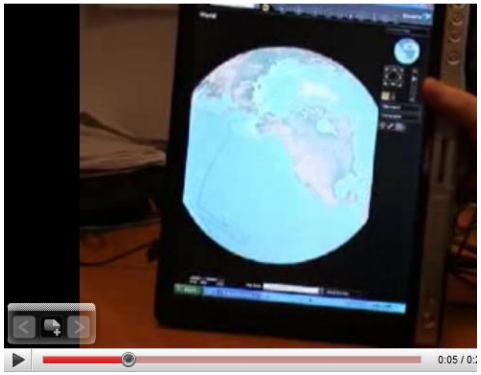


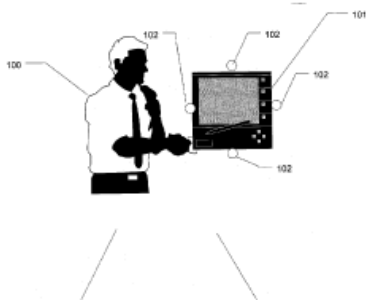
SenseCam trial with amnesia patient

- Cambridge Memory Clinic, Addenbrooke's Hospital
- 63 year old, well-educated, married woman 'Mrs B'
- Diagnosed with limbic encephalitis in 2002
- Now has marked amnesia
  - usually no memory a few days after an event



Microsoft GyroTablet handheld computer with motion detection





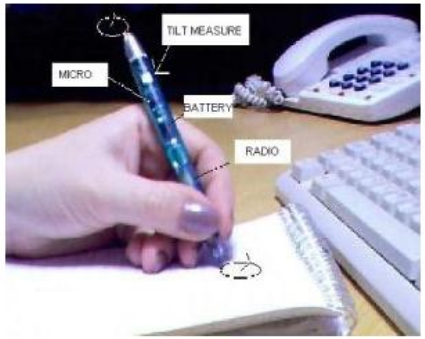
XWpen – 2001

A few years back, researchers at Microsoft created the XWPen. The XWpen was an interesting device which had a built in handwriting recording circuit which could fit in the space that and ink cartridge would take. The circuit has a tilt sensor which tracks movement of the pen. By transmitting this information to a computer near by it can then put what you write or scribble down on to the screen. It uses an RS232 port on the PC to track this via a radio transmitter at 1200 baud rate.

No doubt this technology could be superceded now, but for back in the days it was a nice step forwards and quite a cool idea for it's time.

Via: Microsoft

View all posts by Matthew Newill



Gyrotablet

- Video from Youtube as here

SenseCam

VICONREVUE

REVUE 3MP HARDWARE

Welcome to the next generation Revue. The Revue 3MP now has four times more storage, a 3 megapixel sensor and a new affordable price of £299. Clinicians and researchers will now get much more detailed images while still storing days of photos.

Revue 3MP is shipping August 2011, register your interest today by **completing our online form** and ensure you're the first in line when it ships.

REVUE 3MP KEY FEATURES

- 3 megapixel sensor
- 6.5cm (w) x 7.0cm (h) x 1.7cm (d)
- 94g weight
- 8GB memory
- Temperature sensor
- Light color and intensity sensor
- Infrared motion detector
- Multi-axis accelerometer
- 3-axis magnetometer (compass)
- Battery and flash memory

REVUE 3MP EXAMPLE IMAGES

Click images to view in full size.

Girton Labs projects 2007 -2011

- Start with Sensebulb

A BRIGHT IDEA FOR SENSING

Can forgetful people now relax?

Also on show was the SenseBulb, a light bulb with a standard fitting but with low-power, high-brightness LEDs inside, along with a great deal more technology.

Developed by Lyndsay Williams of Cambridge's heads up Girton Labs, the device uses four sensors known as thermopiles - the same kind of detector found in heat-seeking missiles. They sense temperature differences accurately and over a short time from a narrow angle.

Put one in the kitchen, for instance, and it won't register a pot boiling on the stove. However, it would note that the oven was over its usual temperature, or that the fridge or the back door had remained open for a time.

With a SIM card built in, it can be set up to send text messages automatically to a specified recipient whenever temperatures in a given part of the home fall out of a set range.

The thermopile sensors could even, Ms Williams said, register the waving of arms - and for this reason she said it could be an unobtrusive and passive movement sensor for Alzheimer's patients or elderly people who live alone.

SenseBulb

- A new design of very low power LED light bulb and wireless sensor computer
- The SenseBulb has novel non-contact sensors to detect incidents in the home e,g, a door left open or a person falling

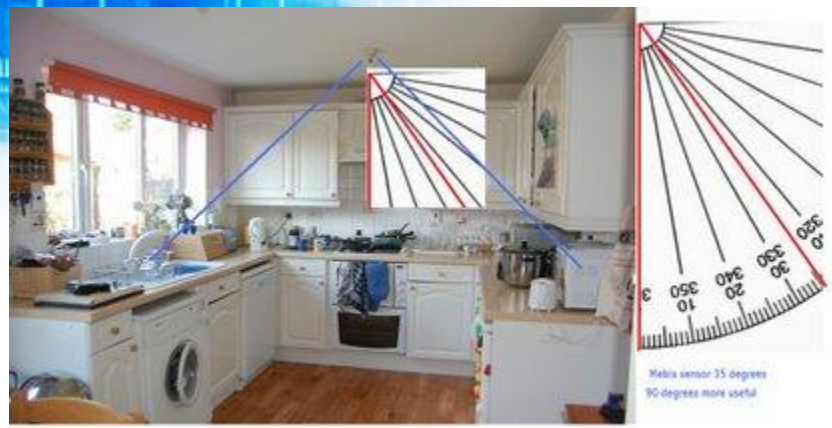
- SenseBulb is also useful for security systems in the home and office
- Sensebulb can recognise gestures, e.g. waving a hand at a bulb can indicate "help" and the bulb will respond with a message to a mobile phone

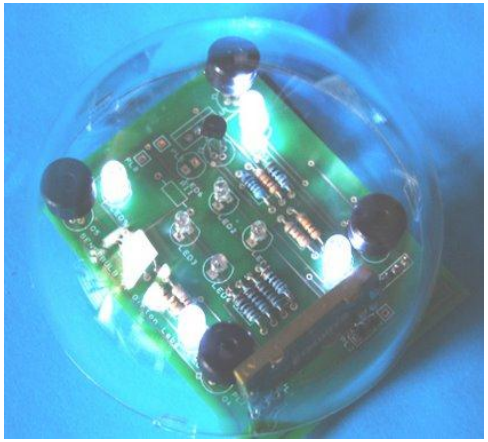
SenseBulb

- A text message can be sent to a mobile phone
- Alerts takes typically only15 seconds to detected and then be received by a remote mobile phone under experimental conditions

- Any mobile phone can be used to receive messages.
- SenseDirect's wireless sensor technology is used to enable the texting feature of SenseBulb.

SenseBulb



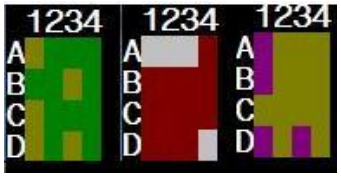


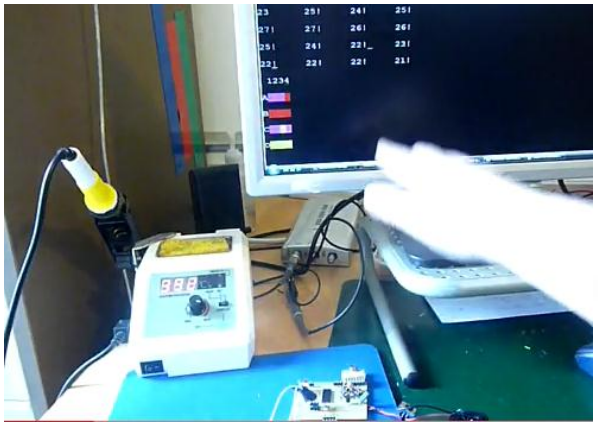
SenseBulb

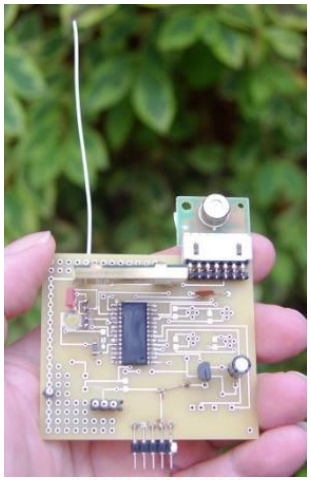
- Setup of each SenseBulb is achieved by sending a SMS message from a mobile phone and no PC connection is required
- SMS messages can also be sent to landline phones, using text to speech conversion to provide a voicemail message
- Typical application could include aiding dementia care and Alzheimer's patients, monitoring of doorways and corridors etc.

Sensebulb , Microsoft Kinect

- Slight similarities between the two
- LW started human heat tracking camera work at Microsoft Research in 2007 – for gesture control
- Left to form Girton Labs in May 2007
- Filed patent on heat tracking camera using thermopiles to detect movement of people in a room, and detect gestures in 2007
- SenseBulb similar to Kinect but SB scans much faster 200 times sec v 30 times sec, battery powered and wireless , works in 3D with wall and ceiling sensors
- Applications in care of people in home, and for mobile phone control , vehicle control not gaming
- Microsoft Kinect using different technology, higher resolution now bought from company in Israel , uses about 100 times more electrical power
- Video here







SenseSurface

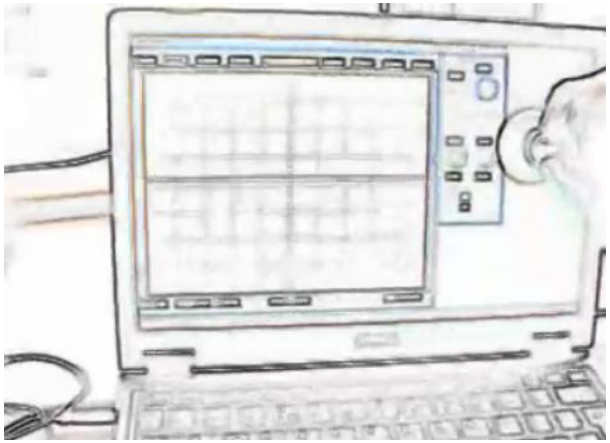
- A unique sensing x/y matrix is attached to the rear of the laptop screen to detect the control's position
- The distance of the sensor from the screen can also be detected.

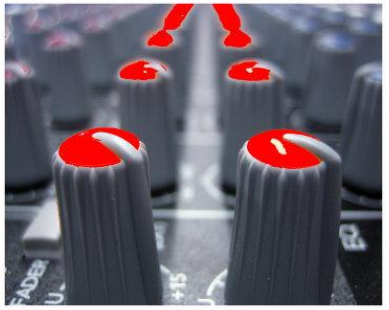
SenseSurface

- A 3 Dimensional touch control surface for PCs, music synthesisers, printed books, etc.
- A control surface with real knobs, sliders, real switches
- The sensing knobs have a custom designed movement sensor to determine position within a range of 180 degrees with a 10 bit digital output
- The magnetic knobs can be removed and repositioned immediately by picking them up and moving to a different part of screen

SenseSurface video – control knobs

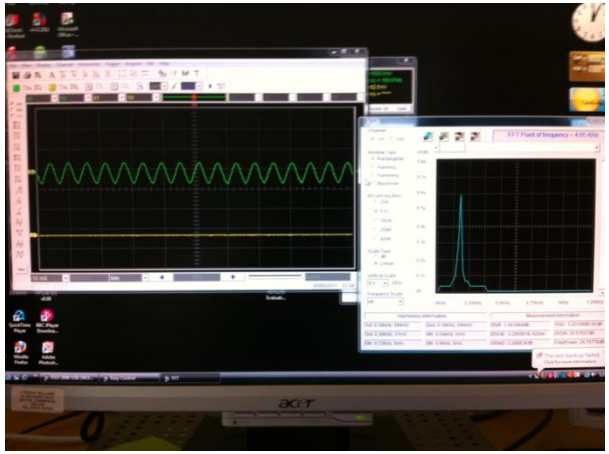
- Video from youtube as here





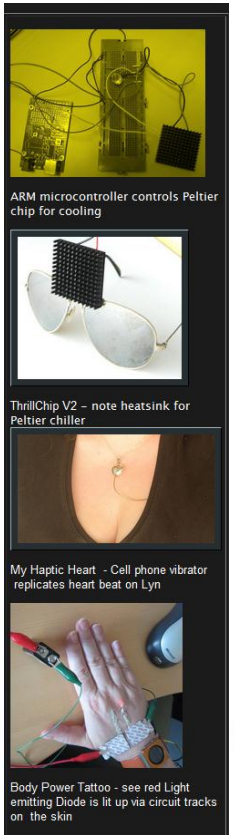
Early onset epilepsy detection for Northumbria University

- Williams August 2010- June 2011
- Uses FFT to distinguish shake from large hand movement



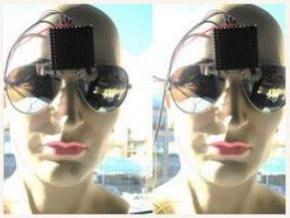
Thrill Chip

- Record and replay of skin sensations e.g. touch
- Ski run
- Record GSR , heartrate, motion
- Replay feeling with skin actuators, chill,
- heat, nerve stimulation
- Video
- http://tinyurl.com/6eyvko9



Skin record and replay

CAMBRIDGE 'THRILLCHIP' MEASURES EMOTIONS DURING 'SEX OR SKI RUNS'



Cambridge inventor Lyndsay Williams is developing a sensor device called a 'ThrillChip' that captures people's fear and excitement during special moments and allows them to replay a recording of their real-time emotions – much the same as they would a wedding video.

Being able to record and replay emotions is a holy grail of many technology areas – especially the games industry – and Williams is confident she holds the key to a potential commercial bonanza.

The 'ThrillChip' will faithfully capture the adrenalin rush of fear and excitement in a range of experiences from sex to ski runs, from carousels to car crashes, although Williams suspects games industry players may provide one of the earlier routes to market.

"Imagine the ThrillChip used as an advanced games controller: It can feed back every thrill a player feels as they experience it. This is gold dust feedback for online games companies – of which there are many in Cambridge – as they look at what works and what doesn't work so well so they can adapt and improve future games.

"Imagine replaying and sharing all the physical fear or excitement of your last ski trip, car crash, meeting your boss for a career review, setting the office on fire (again!), first date or rollercoaster ride. Or you've had a hard day at the office and just want to chill out - for real. The ThrillChip prototype is working in trials and I believe it could be common place within five years."

Her last working prototype for Microsoft Research Cambridge – before she left to found Girton Labs – was BioSenseCam. As well as the SenseCam which records all life's images, movement, temperature etc, the BioSenseCam goal is to record all life's physical feelings, such as fear, excitement, arousal, pleasure etc and to replay these feelings in a human. Hot and cold temperatures, and other electrical stimuli are induced into your forehead or back of neck via computer control.

Feelings are recorded with biomedical sensors, such as heart rate, Galvanic Skin Response (records sweat), respiration. After recording, some of these emotions can be physically replicated, via a Peltier heat exchanger, in the person by a novel haptic device, the ThrillChip, which is the size of a coin.

The user can watch the Sensecam video and via the ThrillChip connected to the head, the fear, excitement, surprise, pleasure and so on are replicated. Head movement will be able to control the intensity of the effect.

Williams said: "I have built an ARM microcontroller-based prototype of this and it is currently in test on a young male dancer. All SenseCam recordings capture temperature, so you could replay your vacation movie and feel the heat on your neck or the chill in your spine of your ski trip.

"Heart 'bump' is replicated with another device, a haptic pedant. This can be replicated by holding a mouse or cell phone. Each person feels the other's heatbeat in their hand. Other applications could be a black box data recorder; an aid in medical diagnosis. ThrillChip applications could also include possible games, Xbox, amusement rides etc."

Williams is in demand in many other areas of cutting-edge technology. She is exploiting her own IP in developing a prototype diagnostic device for early-onset epilepsy. And for a US client, she is developing a new hi-tech, low power sports watch.

She is also engaged by Apple as a consulting expert and has worked with its legal team on enhancing the patent portfolio regarding the iPhone. Williams registered a 1997 patent on an i-Phone-style device.

"Microsoft could have had the rights for next to nothing but said they were underwhelmed by my invention and there was no way a device packing all that technology would work without a keyboard," she says.

"I emailed BT a drawing of my design – everything about it was innovative from the curved shape to the technology inside it and the way it worked. BT saw the merit of the idea and gave me a year's contract but I signed away my rights; think I got £1 in return or something.

"I was an engineer and that's what I knew and did best: I couldn't afford lawyers so I had no negotiating power. I was 37 with a two-year-old child and unemployed husband.

"Not so long ago I was approached by Apple lawyers who said 'You know we have bought your patent' – I didn't know as it happened. You cannot change an original patent but you can add new claims elements.

"They flew me out to Apple HQ in Cupertino to check that I was the bona fide inventor of the device I had engineered and patented; the latest patent awarded to Apple last week is recorded in approximately 2,862 pages of court documents now in the public domain on the web.

"Apple takes the IP protection of this device very seriously and has already faced down patent trolls in the States. Apple have done things the right way in terms of acknowledging my original invention and then paying me for my time."

Legal experts in the States would now expect Apple, armed with the reinforced patent protection, to retrospectively seek licensing fees from companies selling similar devices.

BUSINESS WEEKLY
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21 years on the inside track of Cambridge & East of England technology, research & industry

Girton Labs

- Any Questions?
- Contact Lyndsay Williams, Managing Director of Girton Labs, sensecam@gmail.com
- More details www.girtonlabs.com
- www.sensecam.co.uk

Extra slides

Ice-Pen

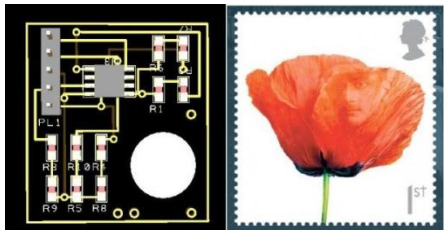
- Peltier Heat Exchanger - pain management
- Used on headaches
- Case and computer hardware designed by Girton Labs, 3D printed case manufactured by Philips, Shapeways

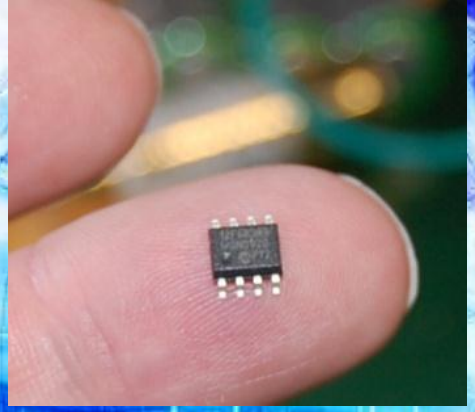
SenseBooks

- SenseBooks are a new type of interactive printed book using sensors to determine activity of the reader
- These sensors are similar to those used on the Apple iPhone. e.g. light, motion, sound and touch
- The SenseBook will be able to automatically indicate to your computer via wireless what page it is on which could then take the user to further content on the web etc.

SensePaper (ipx notes)

- Ixp-Note is a new form of intelligent sticky note that allows the user to create time sensitive paper.
- Time and date is selected via a novel paper touch sensitive sensesurface. The card will light up and chime at the chosen time.
- The Ixp-Note sensing platform starts at coin size and can be attached to paper surfaces
- It is designed to be used like a normal sticky note and also to be re-usable.



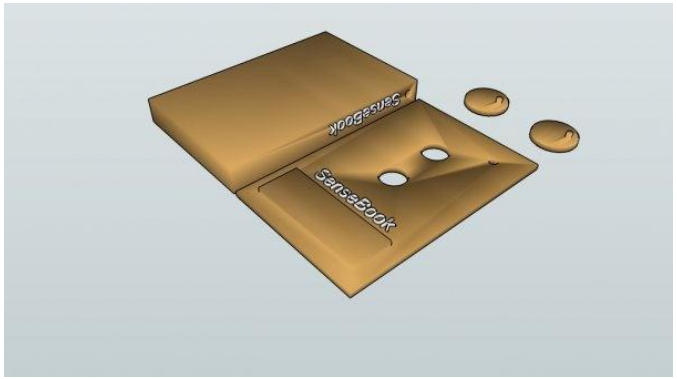


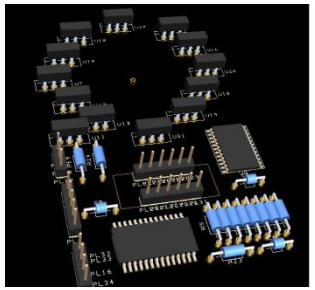
SensePaper technology

- Nanopower 8 bit PIC microcontroller - 2Volts
- Thin Sensors such as temperature, vibration, touch, sound, light
- Output, LEDs, audio, serial, wireless
- Graphics combined with sensors e.g. drink mat
- No PCB, laminated within 2mm thin card inc battery and paper
- Waterproof, flexible, robust,
- Battery life up to one year
- Applications, Alzheimer's, appointment cards, asset tracking, medical applications – smart plasters

Girton Labs Technology

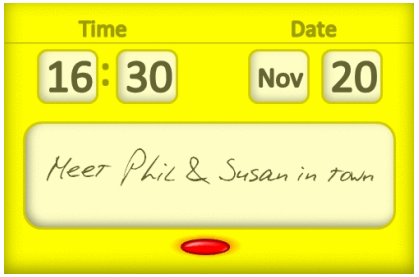
- Innovative portable computer designs
- Microcontroller hardware and software design
- Very low power microcontroller designer
- 3D CAD design and manufacture





SensePaper (ipx notes)

- The user can write a note on a reusable writing strip.
- The idea was originally designed for people with memory loss, e.g. Alzheimer's, but can be used all around the home and office.
- The multi-touch technology is designed to be very simple and intuitive to use without the challenges of conventional reminder systems.
- The notes are credit card sized and designed to use like normal sticky notes.

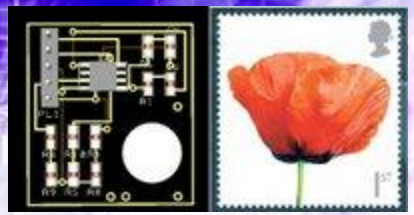


SenseBooks

- A Sensebook will also know the book has been picked up and that the reader is looking at a page.
- Very low cost magnetic motion sensors allow movement to be detected. These novel motion sensors are a replacement for accelerometers and much lower cost.
- We plan to use printed electronics on paper for part of the SenseBook and the sensing system should add no more than about 20% to cost of any printed book.

SensePaper (ipx notes)

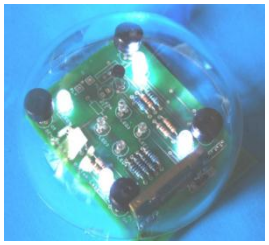
- A novel design of power management which works like the human heart is used to achieve very low power. Battery life approx 1 year
- The technology that enables this utilises low cost electronic circuit printing.
- The platform including hardware and firmware costs around $1.
- Low cost achieved due to novel connection technology. This replaces a conventional printed circuit board (PCB) and costs < 1 cent per card.



Technologies

- SenseBooks
  - SenseBooks is a new type of interactive printed book using sensors to determine activity of the reader.

- SenseSurface
  - 3 Dimensional touch control surface for PCs, music synthesisers, printed books
- SenseBulb
  - A novel non-contact sensors to detect incidents in the home, e,g, a door left open or a person falling in the home



Our Technologies

- Sense Direct
  - A wireless GSM sensing network technology

- SensePaper (ipx notes)
  - Ixp-Note is a new form of intelligent sticky note that allows the user to create time sensitive paper

iPhone heartbeat

optical sensor (camera) and flash record heart rate

vibrator motor replicates heart beat