Sense and Sendability – Novel Mobile Devices for the Future

- Oxford ICT Forum Conference
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- 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.
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.
William’s History

- 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
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.

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 Steve Le, 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.

(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. 7,964,859 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. 6,866,584 on “portable computers” (not previously asserted; Apple acquired this one from British Telecom in 2008)
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
Apple bought patent ‘564

- 2800+ pages in public domain re lawyers working on patent ‘564 at USA patent office.
HTC share price hit by latest Apple patent infringement claim

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
- April 1997: BT filed patent '564 in Oct 1998
- 1997-2011: Timeline of events
  - 1999: LW went to work for Microsoft
  - 2004: Patent awarded to BT
  - 2006: Apple bought Patent '564
  - 2007: Apple/HTC issue patent '564
  - 2008: 12 July 2011
  - 2009: Apple awarded Patent
  - 2010: 23 May 2011
  - 2011: iPhone released
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.
SenseCam trial with amnesic 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
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
• Video from Youtube as [here](#)
SenseCam

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

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
• A text message can be sent to a mobile phone
• Alerts takes typically only 15 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

• 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](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
daily 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 adrenaline
rush of fear and excitement in a range of
experiences from on to off runs, from car-crashes
to car-stashes, although Williams suspects games industry players may provide one of the earliest
reducers to market.

“I 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.”

“So far my research prototypes have been with automatically generated data and models, and I am considering the use of a physical device like the ThrillChip, which could be used in a variety of games. The user would be able to control the intensity of the effect.

Williams said she has built an ARB microcontroller based prototype of this and it is currently in use on a young male dancer. All SenseCam recordings capture fear, so you can replay your favorite movie and feel the fear in your neck or the chill in your spine of your ski trip.

“Fear responses” are replicated with another device, a haptic pad. This can be replicated by holding a mouse or cell phone. Each person feels the other’s fear. Other applications could be a brain-computer interface or a medical diagnosis. ThrillChip applications could also include

Williams is in demand in many other areas of cutting-edge technology. She is exploring 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, apps which

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 iPhone-style device.

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

“I emailed Bill a drawing of my design — everything about it was innovative from the curved shape to the technology inside it and the way it worked. Bill gave the most of the idea and gave me a year’s contract but I signed away my rights. I got £1 in trains 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 57 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 — we didn’t know how 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 it was the balsa wood inventor of the device I had engineered and patented; the latest patent awarded to Apple last week is recorded in approximately 2,463 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 licensed patent trolls in the UK. Apple has 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.
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.
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
optical sensor (camera) and flash record heart rate

vibrator motor replicates heart beat