Paper computers and other everyday computational things

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My story begins with the Egyptian monk Cosmas, who in 547 AD in his Topographia Christiana argued on theological grounds that the Earth was flat, a parallelogram enclosed by four oceans, because it should fit the Ark of the Convenant which was supposedly a parallelogram as well.
Now you may think that arguably today’s hottest computing technology, the iphone, is cool,

But I have news for you.

1500 years later, the world is still flat.
Wouldn’t it be much neater if your iPhone did this?
User interfaces with non-planar displays that may actively or passively change physical shape

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So iPhone is really just a small Mac II with a touch screen
Even the multitouch is really just pinch. 2 touches. Wow!
It appears there has been little innovation in the past 40 years of HCI
And in some ways the cellphone user experience is worse from what it was 10 years ago
the clamshell phone had some really nice features:

- Its form factor morphed to your body and to the task: You could pick it up by flexing it open and drop the call by flexing it shut. Very cool.

- When open, the form factor would morph to fit your facial features, with the microphone near your mouth and the speaker near your ear.

- And when closed, the keyboard was protecting and wouldn’t generate spurious input, and the screen was protected from scratches as well.

- Plus the thing was designed to do only one thing, and to do it well: to make a call. It was a phone. Not a computing device with 100 different functions.

Just a phone. And there is something beautiful about that.
Because there is one form factor it may not be suitable for any one particular task

You don’t eat soup with a fork.

We need the user interface to fit the data. This is especially relevant to Geographic Information Systems.
Where could things go instead? how could we specialize devices according to form factor?

well to give one example two years ago we designed PaperPhone: the world’s first paperthin smartphone.

Despite the holes in my pants left by my iphone I am not arguing that paper is a better form factor for a cellphone but there are lots of applications that benefit to displays being thin and flexible like paper.

I can have leave like paper, I can have a mailbox on a piece of electric paper. I have many screens each of which is dedicated to a particular task.

so remember: You don't eat soup with a fork
Here’s how it works.
So does that mean there has been no progress in user interface research?

Quite the opposite. We are now in a time of revolution in user interface technologies, akin to the home brew revolution in the late sixties.

It is driven by a few factors.

1) Maker culture. Technology has commoditized such that now anyone can build anything. Democratization of artefact manufacturing. This also means industrial designers no longer need computer scientists to do interaction design. This includes 3D printing which will cause another industrial revolution.

2) This is the one we really focus on. Display revolution. These don't come along very often, once every 20 years if you're lucky.
CRT invented by Karl Ferdinand Braun in 1897 resulted in the trackball in 1951 by Tom Cranston and Fred Longstaff (a Canadian invention as evidenced by the 5-pin bowling ball), the first electronic x,y input device, and the more famous mouse in 1963 by Doug Engelbart at Stanford.
The invention of the LCD in 1968 by George Heilmeir at RCA, allowed Alan Kay to think of interacting with a tablet pc form factor known as
Dynabook, which featured a stylus input.

This led to multitouch, pioneered by another Canadian, my mentor and dear friend Bill Buxton in 1984, and to Mark Weiser’s 1989 ubiquitous computing revolution that we are now a part of.
So in the early 2000s flexible displays came along and I knew this would again change everything.
So we started thinking about what this would mean for interaction. And we came up with a couple things for PaperWindows back in 2004:

Multidisplay, just like paper, removes the emphasis on focusing attention on one screen, improves multitasking.

Using Bend interaction techniques for navigation just like paper, increase the tactile/kinesthetic navigational feedback allowing partly eyes-free operation.

And most importantly, allowing the display to fit the human body as well as the data displayed on it.
And that's one of the things we are working on at the Human Media Lab: paper computers.

This year developed PaperTab, the world’s first paper tablet computer made out of many thin film displays. I have some with me here.

PaperTab acts just like paper in your office. And this is going to revolutionize the office space.

Stacks of a few displays will supplant piles of paper.
Show demonstration of PaperTab
PaperTab uses flexible E Ink by a company called Plastic Logic.

Another technology that will become very important are flexible OLEDs or FOLEDs. They will take over the world of displays, as they are cheaper to produce.

If you don’t believe me who of you still owns and regularly uses a CRT?

FOLEDs will initially replace cellphone screens and other rigid flat screens, but eventually companies will realize that they provide these extra user benefits

These include being able to wrap screens around 3D objects providing the data in the shape it is in.
This means every product could have a skin made of pixels and we need to stop talking about devices.. or technologies.... and just create everyday things that are computers.

Single purpose objects that have a shape based on the actual function of the device.

Every product will only serve the function of what it was built to do, with the flexible display providing services such as social networking or ordering services, or maybe just a nice skin that can change with your moods.

But maybe I dont want a beer bottle wrapper to show me my email.

I want it show me everything about where the beer came from, what ingredients are in it, and how I can order more. And I want it to be a kickass drinking experience. I do not want to have the computer impact that functionality which is key: the physical functionality of the device. (show beer bottle).
the computer inside could augment that with digital functionality, marrying digital with physical in a perfect way: bits becoming atoms. (show video of dynacan)
So one of the first non-flat rigid display in which we could fit a projector was an interactive spherical display.

And to quote Frank Loydd Wright: Form equals Function. It does not follow it. They are one and the same.

Our first globe was actually made out of a $20 toys are us globe and we used a 250,000 dollar motion capture system to animate it with a multitouch system in the spring of 2008.

Now it has become a mainstream product through companies like Pufferfish in the UK.
So this is what our spherical computer looks like now. You can do full multitouch selection of locations, zoom in onto areas of interest, and click hyperlinks that make things appear on other screens.

And yes: you can show your aircraft’s range without any distortion what so–ever.
So the next shape we focused on was a cylinder to fit the human body (show le corbusier modulor system)

This led us to do both a video conferencing system and a human anatomy browser that is fully 3D, that is stereoscopic, and fully 360 motion parallax.
The beauty of the cylindrical shape is that unlike a sphere it does *not* distort the image along the Y axis, so wherever you stand you get essentially a flat display the size of a human. And you can walk around it as you would in normal life.
When Interacting with TeleHuman users get full stereoscopic views when wearing shutter glasses, they can see their remote participant from all sides creating a richer telepresence experience.
So Display shape equals function. So what about gestural input you might ask?
Will they change the way we are going to interact with computing devices? Absolutely not.

There will be elements of it that will stay, if you control a large wall sized display you have to use something like a Kinect.

Gestural control will be important in gaming, but as a general control for user interface design: IT IS ALL ABOUT TOUCH
Because the thing that is missing in computer interfaces today is the tight physical coupling between the user and the data that you see in, for example, in the violin interface.

It allows that interface to fully become an extension to the body.

The vibrating string represents the pitch in your ear and the synergy is what makes that such a powerful tool.
Why want a holographic display when you can actually touch the 3D image?

Claytronics will do that. Hundreds of thousands of tiny robots that can climb on top of each other and each robot is a 3D pixels.

So you could construct a 3d model out of these and you could touch the data as if it was really there

While this is a thing of the future, it is something I want to hold in my hands today.
Eye Contact Sensors solicit a bright pupil effect by flashing invisible light into the retina of the onlooker. This light also produces a glint on the cornea, which allows computer vision algorithms to determine co-location of glint and pupil, which signals that a user is looking at the sensor.

Eye Contact Sensors are simplified long-range eye trackers that can tell whether a user is looking at your equipment or not. Our megapixel versions operate at up to 10 meters, with multiple users and without any form of calibration. Various forms of eye contact sensors are at the core of our attentive user interface applications. You can use them to track who's looking at your screen ads in a mall. Detect when a customer is looking at your product display. See what movie poster your audience is interested in. Or control your home theatre or first person shooter games with your eyes only.
Flash
As a designer of interactive technologies I want to literally touch people.

And this means working to design for their sensorimotor capacities, which you see mapped here: and that means THE FINGERS.

CRTs produces input devices for one hand. LCDs produced input devices for 10 fingers.

Organic User Interfaces allow the full dexterity of our fingers to finally come at play, not only in three dimensions, but with full haptic experiences at that.

I look forward to that future. Thank you very much.