From: [redacted] <[redacted]>
Sent: Tuesday, August 16, 2011 6:48 PM
To: Jeffrey Epstein
Subject: RE: FW: Epidermal Electronics and Electronic Second Skin

steve is great.
:-)

From: Jeffrey Eps=ein [jeevacation@gmail.com]
Sent: Tuesday, August 16, 2011 2:03 AM
To: [redacted]
Subject: Re: FW: Epidermal Electronics and Electronic Second Skin

I read it and loved the idea..... how is it going with=steve

2011/8/16 [redacted] <<=
href="mailto[redacted]">[redacted]

=nbsp;

From:<=pan style="FONT-SIZE: 10pt"> [redacted]
Sent: Monday, August 15, 2011 9:06 PM
To: Bill Gates ([redacted] =
Cc: Boris Nikolic (BGC3) ([redacted]); Lowell Wood
[redacted])
Subject: Epidermal Electronics and Electronic Second Skin
Importance: Low

Pre=ty neat – I'm not sure if you've seen this.

The=e are a couple of areas where further development is needed…RF communica=ion frequencies change when the circuits are stretched, and dead skin and =weat have to be dealt with during long-term use. These aren't insurmountable complications, though. </=>

Am =ttaching two related papers. Both from Science today. One describes in more detail the "electronic=second skin" and the other about "epidermal electronics."<=u>

The=authors acknowledge medical applications but they seem most interested in =aking this into game controllers. :)

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=emporary tattoos fitted with electronics make flexible, ultrathin sensors<=>

By =a href="http://arstechnica.com/author/kyle-niemeyer/" target="_blank"> Kyle Niemeyer

Mod=rn methods of measuring the body's activity, such as electroencephalograph= (EEG), electrocardiography (ECG), and electromyography (EMG), use electri=al signals to measure changes in brain, heart, and muscle activity, respectively. Unfortunately, they rely on bulk= and uncomfortable electrodes that are mounted using adhesive tape and con=uctive gel—or even needles. Because of this, these types of measurements=are limited to research and hospital settings and typically used over short periods of time because the contact= can irritate skin.

The=e limitations may be at an end, however. New research published in Science describes technology that allows electrical measurements (an= other measurements, such as temperature and strain) using ultra-thin poly=ers with embedded circuit elements. These devices connect to skin without =dhesives, are practically unnoticeable, and can even be attached via temporary tattoo.

All=of the necessary components of the devices, including electrodes, electron=c components, sensors, radio frequency communication components, and power=supplies, are set within an extremely thin (about 30 µm) elastic polyester sheet. The sheet has a low elastic =odulus (that is, it's flexible) and no noticeable mass (about 0.09 g), so =ou have a lightweight, stretchable membrane.

Cir=uit elements (such as transistors, diodes, resistors) and sensors are cons=ructed with typical materials like silicon and gallium arsenide, but are l=nked using nanoribbon and micro/nanomembrane elements to allow extremely small but flexible designs.

The=authors refer to their approach as an "epidermal electronic system&qu=t; (EES), which is basically a fancy way of saying that the device matches=the physical properties of the skin (such as stiffness), and its thickness matches that of skin features (wrinkles, cre=ses, etc.). In fact, it adheres to skin only using van der Waals forces—=he forces of attraction between atoms and molecules—so no adhesive mater=al is required. Between the flexibility and the lack of adhesive, you wouldn’t really notice one of these attach=d.

One=of the coolest aspects of this technology is the application method: tempo=ary (transfer) tattoo. Yes, the ones you used as a kid, where you hold the=transfer sheet with the design onto your skin then dampen it to dissolve the sheet. Here, they used water-solu=le polyvinyl alcohol (PVA) sheets in the same manner.

For=a power supply, initial designs used silicon photovoltaic cells to generat= electricity, but these are limited to microwatts due to the small area. R=searchers also explored wireless inductive power, where an external transmission coil matches the resonance frequency=of a small inductive coil in the device (it's the same sort of tech that's=used in wireless device chargers). This opens up the door for applications=that need more power than solar can provide, or for devices that work in low-light conditions (under cloth=ng, for example). The authors also suggest future electrical storage using=capacitors or batteries.

As =emonstrations, the authors used their devices to measure heartbeats on the=chest (ECG), muscle contractions in the leg (EMG), and alpha waves through=the forehead (EEG). The results were all high quality, comparing well against traditional electrode/conductive =el measurements in the same locations. In addition, the devices continuous=y captured data for six hours, and the devices could be worn for a full 24=hours without any degradation or skin irritation.

One=interesting demonstration that also suggests future applications was the m=asuring of throat muscle activity during speech. Different words showed di=tinctive signals, and a computer analysis enabled the authors to recognize the vocabulary being used.<=p>

The=team even hooked one of these sensors up to a simple computer game (Sokoban) a=d used throat activity as the controller. Identifying each word took about three seconds using a MATLAB program, but=it had a higher than 90 percent accuracy. While the potential videogame ap=lications are endless, you can also think of other areas, such as silent c=mmunications or better voice recognition software.

[redacted] [redacted]

[redacted]

Bill & Melinda Gates Foundation<=>

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