From: Jeffrey Epstein <jeevacation@gmail.com>
Sent: Tuesday, August 16, 2011 7:00 PM
To: [redacted]
Subject: Re: FW: Epidermal Electronics and Electronic Second Skin

what will happen , vs balmer.?

2011/8/16=[redacted] <[redacted] <mailto:[redacted] >

steve is great.
:-)

From: Jeffrey Eps=ein [jeevacatio=@gmail.com <mailto: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]"
target="_blank">[redacted]>

=C2

From: [redacted]
Sent: Monday, August 15, 2011 9:06 PM
To: Bill Gates ([redacted] <mailto:[redacted]>)
Cc: Boris Nikolic (BGC3) ([redacted] <mailto:[redacted]>); Lowell Wood ([redacted])
Subject: Epidermal Electronics and Electronic Second Skin
Importance: Low

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

There =re a couple of areas where further development is needed...RF commun=cation frequencies change when the circuits are stretched, and dead skin a=d sweat have to be dealt with during long-term use. These aren't insurmountable complications, though. =</u>

Am att=ching two related papers. Both from Science today. One describes in more detail the “elec=ronic second skin” and the other about “epidermal electron=cs.”

The au=hors acknowledge medical applications but they seem most interested in mak=ng this into game controllers. :)

Tem=orary tattoos fitted with electronics make flexible, ultrathin sensors<=u>

By Kyle Niemeyer

Modern=methods of measuring the body's activity, such as electroencephalograp=y (EEG), electrocardiography (ECG), and electromyography (EMG), use electr=cal 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 measur=ments are limited to research and hospital settings and typically used over short periods of time because the contact= can irritate skin.

These =imitations 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, electronic =omponents, sensors, radio frequency communication components, and power su=plies, are set within an extremely thin (about 30 µm) elastic polyester sheet. The sheet has a low elast=c modulus (that is, it's flexible) and no noticeable mass (about 0.09 =), so you have a lightweight, stretchable membrane.

Circui= elements (such as transistors, diodes, resistors) and sensors are constru=ted with typical materials like silicon and gallium arsenide, but are link=d using nanoribbon and micro/nanomembrane elements to allow extremely small but flexible designs.

The au=hors refer to their approach as an "epidermal electronic system"=(EES), which is basically a fancy way of saying that the device matches th= 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 =80 the forces of attraction between atoms and molecules—so no ad=esive material is required. Between the flexibility and the lack of adhesive, you wouldn’t really notice one of these =ttached.

One of=the coolest aspects of this technology is the application method: temporar= (transfer) tattoo. Yes, the ones you used as a kid, where you hold the tr=nsfer 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 =ower supply, initial designs used silicon photovoltaic cells to generate e=ectricity, but these are limited to microwatts due to the small area. Rese=rchers 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 th=t's used in wireless device chargers). This opens up the door for appl=cations 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 dem=nstrations, the authors used their devices to measure heartbeats on the ch=st (ECG), muscle contractions in the leg (EMG), and alpha waves through th= 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 in=eresting demonstration that also suggests future applications was the meas=ring of throat muscle activity during speech. Different words showed disti=ctive signals, and a computer analysis enabled the authors to recognize the vocabulary being used.<=p>

The te=m even hooked one of these sensors up to a simple computer game (Sokoban) an= 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]<=p>

[redacted]<=b>

Bill & Melinda Gates Foundation</=>

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