You Name Goes Here

Mr. Jones

10th Grade Legacy 2000

7 September 2017

In the wonderful world of technology, wires can often be a confusing and cluttering, yet necessary component. It's not uncommon to see computer rooms cluttered with tangled wires or a homeowner scratching their head while trying to rewire a light bulb's circuit. A company called Bare Conductive is helping to eliminate these problems and redefine electric circuits through their new product: electrically conductive paint.

This electric paint can be brushed, rolled, stenciled, or penned onto several surfaces including paper, metal, wood, and fabric (Hickey). It acts as a "paintable wire" in which circuits, buttons, etc. can be drawn in unique ways ("Liquid lights…). What makes the paint so special is that it's not only much more simple and versatile than wires, but also that its applications are endless. The non-toxic, water-soluble paint has been used to create lighting circuits that can be activated simply by touching the wall, to create unique instruments that can play any sound with just one touch, and even to teach children the basics of circuitry ("Liquid lights…"). Figure 1 exemplifies a musical instrument circuit drawn with Bare Conductive paint.

The idea for this paint was first conceived by four students at the Royal College of Art in London during 2009 ("Liquid lights…"). The group's initial goal was to create a paint that would allow them to draw circuits on the human body (Hickey). However, they realized that the paint they'd created could work on a much broader scale and decided to sell it commercially (Hickey). Today, one can buy a 10ml pen of paint for $7.80, a 50ml tub for $23.50, or even a 1-liter tub for $260.00. (Bare Conductive).

The paint itself works using carbon, a cheap and commonly-known conductor of

electricity (Hickey). After discovering that carbon is what makes the paint conductive, I realized that I know very little about conductivity in general. This led me to the question: What gives carbon, or any substance for that matter, the ability to conduct electricity? On a closer level, a substance conducts electricity because its atoms contain several *free electrons* ("The Valence Shell"). These free electrons are electrons located in the outer shell of an atom, called its *valence shell*. Because they're located further away from the nucleus of the atom, these free electrons are loosely bound to the nucleus, allowing them to easily flow from one atom to another. Electric currents rely on the sharing of electrons, which is why these freely shared electrons in carbon makes the material itself so conductive ("The Valence Shell"). Substances like rubber and plastic do not have free electrons, which is why they don't conduct electricity well ("The Valence Shell"). These materials with strongly-secured, unshared electrons, are called insulators ("The Valence Shell").

Another question that I wondered about conductive paint relates to how it's being applied and used. What major projects are taking advantage of this incredible electric paint? Perhaps the most prominent project based on the paint's potential was completed by Calvin Harris, a popular DJ (Hickey). For one of his music videos, Harris painted the hands and feet of several dancers with electric paint. They stood on top of a dried pad of the paint— allowing their movements to activate sounds and beats from one of Harris's songs ("Liquid lights…").

While this application of Bare Conductive paint is extremely unique, I feel that the paint can be applied in even greater ways to revolutionize the lives of those in need. This wide range of applications is what really drew me in to the idea of conductive paint in the first place. Currently, somewhat large, iPad-like devices are used to help those suffering with communication disorders such as Cerebral Palsy or ALS ("Dedicated…"). These devices are covered in buttons which, when pressed, play one of thousands of preprogrammed or custom

phrases (“Meet the MiniTalk”). Some of these devices aren’t very large, such as the “MiniTalk”, which has a ten-inch screen and weighs under a pound (“Meet the MiniTalk”). However, Bare Conductive’s electric paint could be the key to making these devices *remarkably* small and convenient. The paint could be used to create a touchpad button layout directly upon a mute or communicatively-disabled person’s arm. Just as with the current devices, each painted button would be paired with its own custom word or phrase, which could be activated with one touch of the hand. This would allow the communicatively-disabled to communicate in a much faster and efficient way than they could using conventional devices. The painted wires would each connect to a very small soundboard containing several programmed phrases and words along with a small speaker to sound the words themselves. Ideally, the entire circuit board and speaker setup could be attached to the wrist and be no bigger than a large wristwatch.

Very small technologies for this painted soundboard concept, as well as the speaker to be used in this application, already exist. A company called Adafruit sells a sound board only 1.5” by 0.9” that is capable of storing 16mb of storage (about 15 minutes of compressed stereo) (“Adafruit”...). A company by the name of NXP released a microspeaker for mobile phones in 2012 that produces a sound over five times more powerful than other speakers of its kind— all while fitting into a single chip (Joire). After researching my further development idea, the closest current invention to it that I found was the Calvin Harris music video project I mentioned earlier in this log. Just as a variety of sounds were triggered when the conductively-painted hands of dancers were touched in the video, my communication device idea would use the touching of a painted arm to trigger words and phrases that need to be spoken. All of this current technology goes to show that effective communication devices painted directly on the skin with Bare Conductive paint are a very feasible technology.

For my extension, I was fortunate enough to interview one of the co-founders of Bare

Conductive paint, Bibi Nelson. Being one of the four students who invented the paint, she is certainly qualified and knowledgeable enough to answer most any of my questions relating to the substance. One of the questions I asked Nelson revolved around the roadblocks she and her colleagues faced while initially developing conductive paint. While I expected her to reply with an answer about the technological difficulties the group faced while inventing the paint in the first place, she said that their biggest problem was *upscaling* the production of the paint for resale. This answer was both fascinating and eye-opening to me. It showed me that in the process of developing new technology, the task of selling it can be even more complicated than inventing it! Another answer that surprised me in the interview resulted from my question about the advantages of conductive paint over traditional wires. At first, I believed that Bare Conductive paint was surely a suitable replacement for wires in a variety of circuits. But Nelson helped me understand that traditional wires are much more useful and safe when dealing with high voltages, while conductive paint is more effective as a discrete *sensor* of electricity rather than a transmitter. I was fascinated by her explanation of the paint's ability to turn everyday objects into interactive, touch-pad like devices. The thought of a simple object like a door frame being able to act similarly to my iPhone blows my mind and shows me the true potential of Bare Conductive paint. Through my interview with Nelson, I gained a greater perspective of the paint— seeing it as a creative outlet for future technology rather than a simple replacement for plain, old wires.

Works Cited

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Appendix:

Interview Transcript:

Cameron Shelley
Mr. Jones
10th Grade Legacy 2000
6 September 2017

Email interview with Bibi Nelson, COO and co-founder of Bare Conductive in London, England (*Bare Conductive*). Nelson earned a MA/MSc in Industrial Design Engineering at the Royal College of Art and Imperial College London, as well as a BA in 3D design from Brighton University (Nelson).

1. Through my research, I discovered that carbon is the major element in Bare Conductive paint that makes it conductive. What made your team choose carbon, specifically, as the main conductive ingredient?

We wanted to make something that was cheap, non-toxic and easy for anyone to use. Most other conductive inks and paints are silver or copper based, which are expensive but usually require solvents to be added to ensure the small metal particles do not oxidise and become non-conductive or they require UV curing or heating to melt the metal particles together.

2. When developing the paint, what technological roadblocks did your team have to overcome?

The main challenge was scaling up manufacture, it's like baking a cake it is easy to make one cake but if you have to make 100 cakes you have to change the recipe as well as the way you mix the mixture. Processing large quantities of carbon is difficult as the conductive powder is very fine and can get into the air and cause problem with electronic parts in the mixing machinery, so you have to isolate a lot of the powder weighing and the way you introduce the powder into the machine's bowl to be mixed.

3. What are some of the main advantages to using "painted wires" in circuitry rather than traditional wires?

Traditional wires are great for many reasons - they are safe for conducting large voltages and currents safely, we do not suggest that Electric Paint is suitable for replacing existing electrical circuitry in a house for example however what it does enable you to do that existing wire cannot do is cover a large surface area very cheaply that you can then turn into a discrete sensor.

4. I'm amazed at how endless the applications are for this paint. What do you feel are some of the most important, unique, or meaningful applications that you've seen Bare Conductive paint used for?

We have a lot of our customers us the paint to make large interactive walls and art pieces, these are really fun and people seem to really engage with them but it hint at the more widely applicable applications we have been looking at.
Some fun things:
https://www.bareconductive.com/news/qa-polyphonic-playground-by-studio-psk/
https://www.bareconductive.com/news/blog-dalziel-and-pows-animated-wall/
https://www.bareconductive.com/news/interactive-wallpaper-alexandre-echasseriau/

The paint allows you to detect the presence of people or animals so it can be used in non-invasive and anonymous tracking of people in a space. This could be used in retail but i can also be used to track elderly people in their homes you could paint door frames or under the carpet and if the elderly person fell over or did not move in their usual routine this could alert someone to check that they were ok.

5. What do you see as the future of conductive paint's development and application?

I think that conductive paint allows us to add more intelligence to everyday non-digital objects. Screens, smart phone and tablets have dominated in recent years as the only interface for a computer or the internet, but we see that conductive paint will allow you to interact with computers and digital information using other interfaces such as the floor, your table or a door frame.

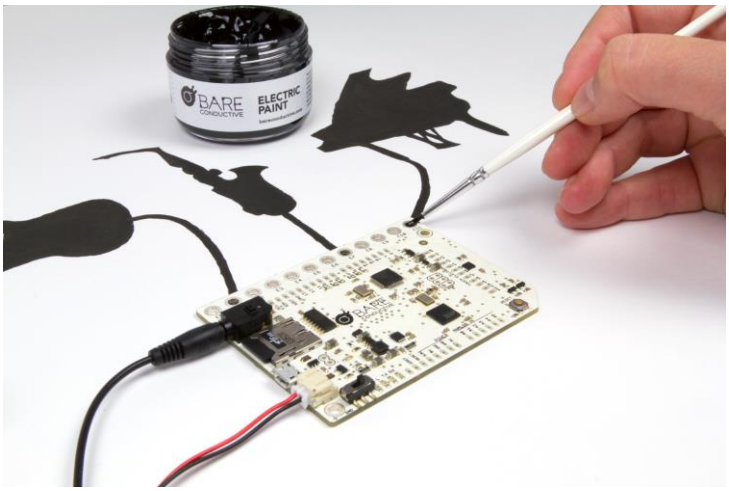

Figure 1. Painting a musical touchpad with Bare Conductive paint. ("Painting a sensor…")