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These Tiny Windmills Work, and Ten Could Fit in a Grain of Rice

By Joseph Flaherty
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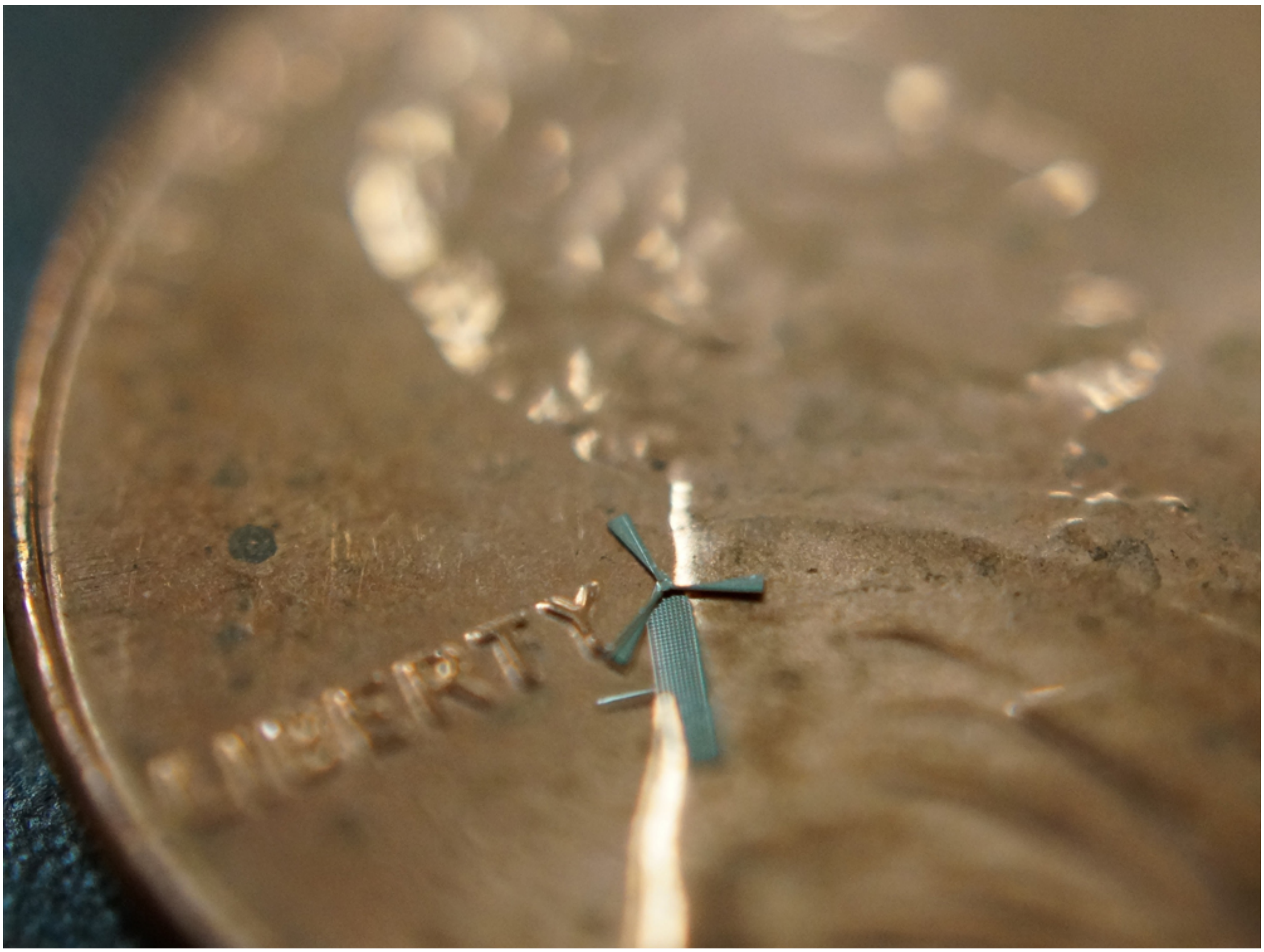


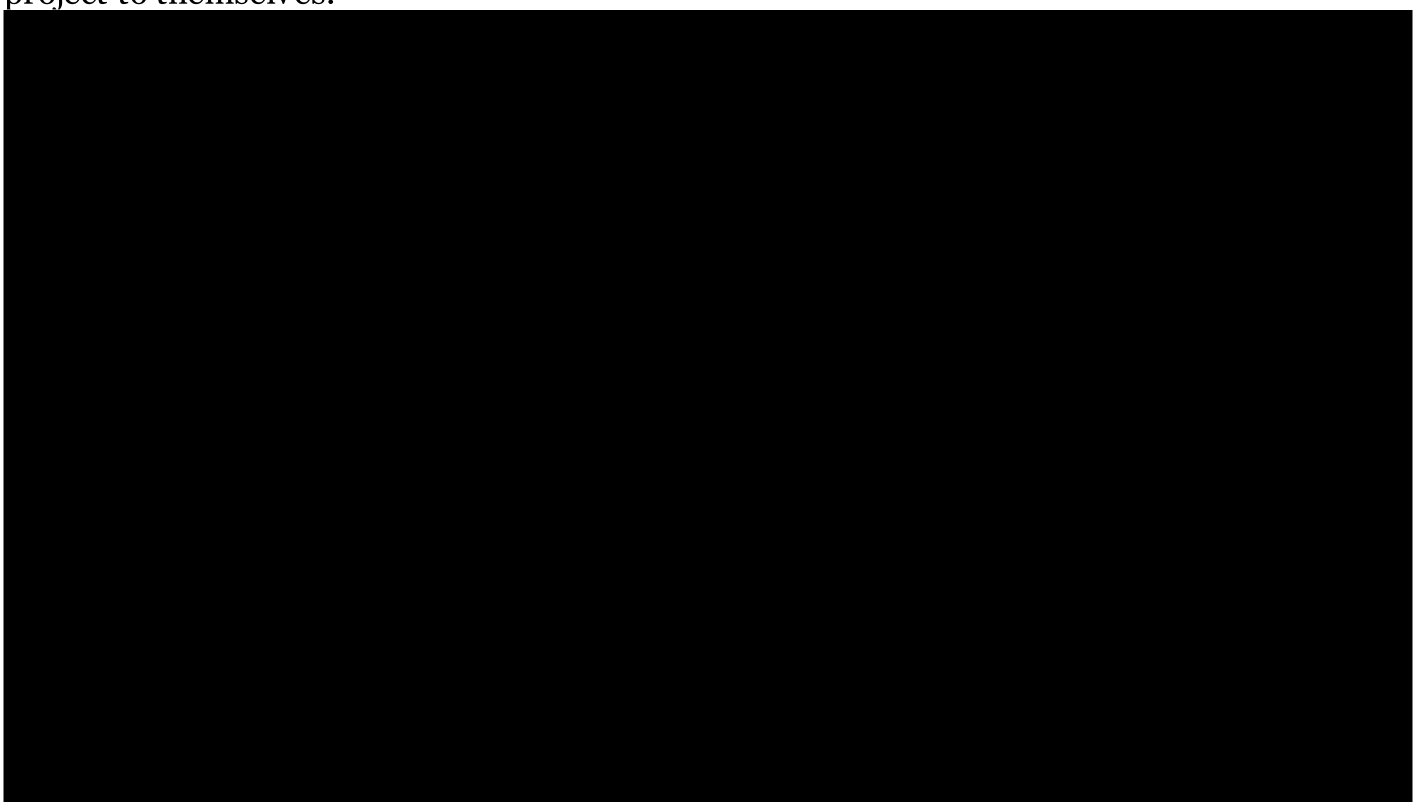
These wee windmills could enable us to recharge our iPhones by blowing on them. *Photo: University of Texas at Arlington*

Imagine a world where your iPhone was out of juice and there wasn't a Lightning cable for miles—wouldn't it be great if you could just blow on your phone to bring it back to life?

Professor J.C. Chiao and Dr. Smitha Rao of the University of Texas at Arlington have developed a new windmill technology that could shake up the power industry and make emergency recharges possible. Unlike the industrial giants that sit in off-shore windfarms, these diminutive devices measure just 1.8 millimeters at their widest point and ten could fit on a grain of rice.

These windmills would be instantly recognizable to Van Gogh, but the itty-bitty blades are examples of a thoroughly modern class of of device called Microelectromechanical Systems, or MEMS. These micro machines are widely used in electronics manufacturing, an average smartphone contains at least half a dozen, but the brittle silicone assemblies are typically reserved for static applications. Advances in nickel-alloys add durability to the structures and open up a variety of applications, including assemblies with highly dynamic parts.

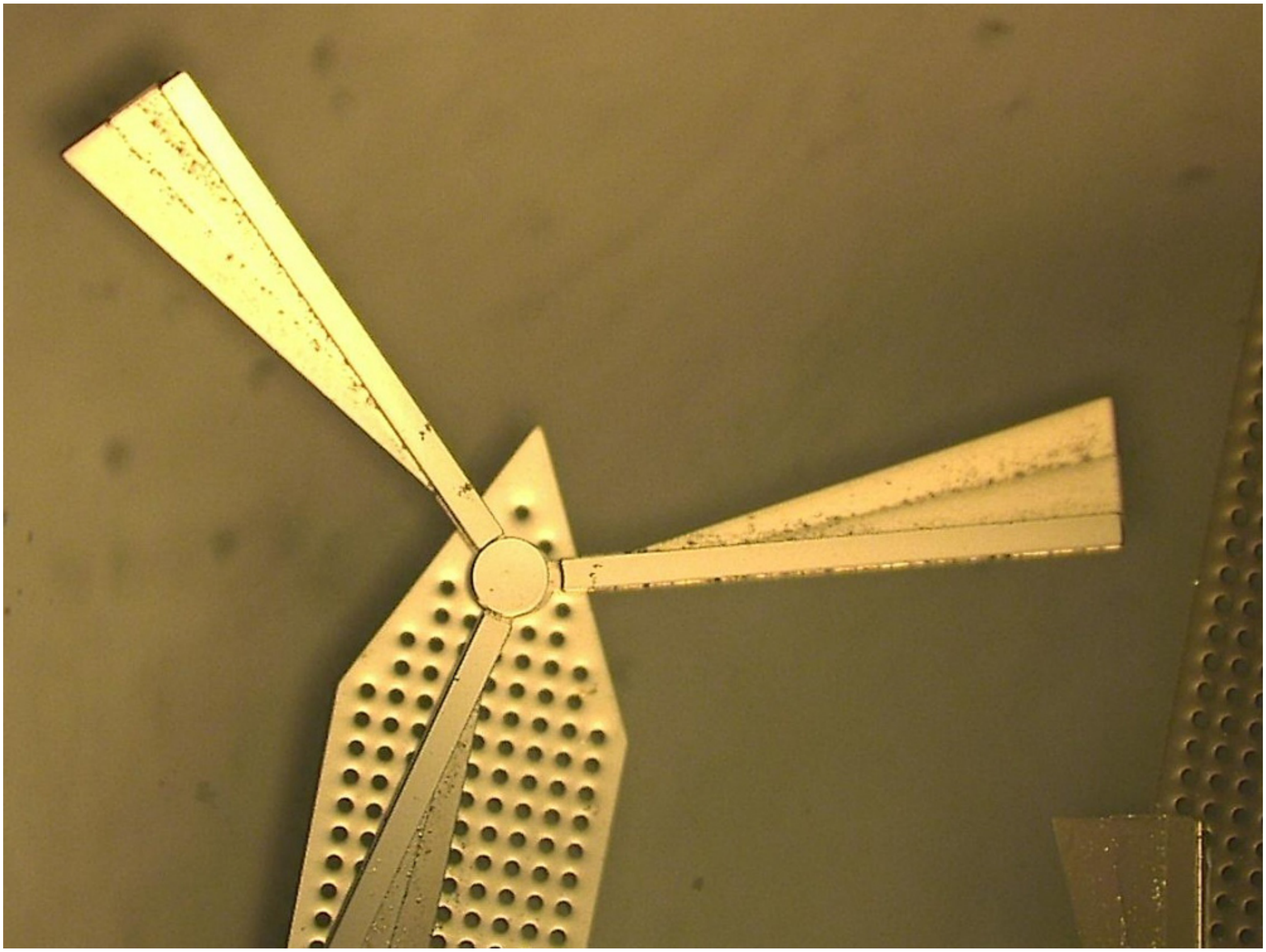
In his courses on MEMS, Professor Chiao often assigns students to design a MEMS windmill with silicone parts. It's an exercise that forces them to look for creative solutions to make up for the material's limitations. When he and Dr. Rao got access to the nickel-alloy, they assigned the project to themselves.



The result is simple, elegant, and owes its development in part to a hyperactive toddler. Dr. Rao played with the concept, came up with 20 different designs, but none were quite right. One day, her daughter burst into her home office with a pinwheel in hand. The slight curvature of the pinwheel's blades inspired Rao to add a subtle dimensionality to her design which improved its efficiency dramatically.

As cute as Chiao and Rao's windmill is, if they ever make it to market they'll be encapsulated by a case to protect them from fingers and other schmutz that could gum up the works. Thousands of the puny power generators will need to be arrayed and harvest the wind as efficiently as possible and the slight ridge on the blades will allow them to transform direct, and lateral winds, into energy.

The design is conceptually brilliant, but Professor Chiao had doubts about its viability in manufacturing. "I was skeptical—we didn't have a lot of experience with these alloys," he says. Prototypes arrived from the manufacturer three months later and testing began. "We tried different wind speeds," says Professor Chiao. "At first, Dr. Rao was very careful and just blew on them gently to see if they would spin and they did. Then she tried a fan, then a hair dryer, then a leaf blower, and the blades survived."



These windmills are high-tech, but were inspired by a child's toy. *University of Texas at Arlington*

Early successes aside, there is a lot of work to be done before these miniature mills will let you toss your Mophie Juice Pack. When something like a windmill shrinks to MEMS scale, designers need to face challenges don't apply to larger designs. Friction becomes a vitally important factor and even little things, like a single dust mote, can bring the whole system grinding to a halt. Even after these deal breakers are addressed, the design needs to be optimized for performance and manufacturability.

Perhaps the biggest challenge ahead is finding a killer app for these teensy turbines. Chiao thinks there could be interesting applications in places solar panels wouldn't make sense, for instance, harnessing the wind that whips through alleyways or under bridges. Another idea is to use them to power sensors that could capture environmental data in far-flung locales. And of course, cell-phone makers have come calling since pictures of the miniature mechanisms have surfaced—though Chiao is sad to report Apple is not yet among the interested parties.

Joseph Flaherty writes about design, DIY, and the intersection of physical and digital products. He designs award-winning medical devices and apps for smartphones at AgaMatrix, including the first FDA-cleared medical device that connects to the iPhone.
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lopan • a day ago
Issues:
1. Durability.
2. Repairability.
3. Safety - i.e., what happens when one of these little blades breaks off and flies into your food, or into your eye, or is inhaled? Probably need to make them out of soft, degradable material for safety reasons, which just adds to the durability issue.

My take in general is that increasing the number of moving parts in a system is a step backward, no matter how miniaturized they are. You're better off developing ways to harvest incident temperature gradients and electrical currents, perhaps including those generated by air friction rather than trying to harvest the kinetic energy of the air.

12 • Reply • Share ›

Michael Lashinsky • 21 hours ago

How do they turn motion into electricity? I don't see a generator. The article completely skips this.

6 • Reply • Share ›

tradergeorge → Michael Lashinsky • 14 hours ago

That is really the trivial part...magnetize the blades slightly and embed a micro coil in the base and you are good to go. The true stumbling block is to get enough output to do anything useful. This thing would be generating pico-amps when we need milli-amps...off by a factor of a billion. There is a reason those hand cranked radios take a lot of revolutions to charge a battery the size of a phone battery. And they are huge compared to this. This may work in concept, but you will need a bucket load of them to do be worthwhile.

2 • Reply • Share ›

chrisnfolsom → tradergeorge • 6 hours ago

The problem is that when you put a load on it it might not even work, and if not done correcltly would create added stresses that would - most likely - reduce the lifespan. Besides, by the time you put it in a box to protect it - the wind wouldn't get to it. ;) You would be much better off putting in some kind of mechanical generator on the soles of your feet - we haven't even talked about the weather - water would really be a problem. Interesting academically, but no where near practical.

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Commuted • 24 minutes ago

Better get started on those tiny generators.

• Reply • Share ›

jayoung • 8 hours ago

embed them into roofing shingles, you could maybe get millions on a good size roof.

• Reply • Share ›

chrisnfolsom → jayoung • 6 hours ago

I just like to think if instead of building all the crap for toys in meals, packaging and such and built small windmills for houses we would have billions of them - even if inefficient it wold be something - instead of landfill.

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