

3D printing's next level: economy cars (w/ video) - TwinCities.com

You can produce a lot of things on 3-D printers nowadays -- fantasy figurines from World of Warcraft, prototypes for implantable medical devices, jewelry, replacement joints, precision tools, swimwear, a replica of King Tut's mummy.

Jim Kor is printing a car.

Kor, an engineer and entrepreneur from Winnipeg, Manitoba, has designed a two-passenger hybrid car of the future dubbed the Urbee. The ultra-sleek three-wheel vehicle will have a metal internal combustion engine, electric motor and frame.

But Kor is printing out the body in plastic, piece by piece, in Eden Prairie at RedEye, a business that uses three-dimensional printers to produce parts and prototypes on demand.

Kor used RedEye a few years ago to create the prototype



Jim Kor of Winnipeg, Manitoba, checks the progress of a car bumper, part of the Urbee 2 automobile, being printed with 3D technology at the RedEye facility of Stratasys in Eden Prairie on Wednesday February 6, 2013. (Pioneer Press: Richard Marshall)

for Urbee, but he's worked out the bugs since then and now says he's ready to go into actual production.

But instead of assembling his Urbees on a Henry Ford-style assembly line the way cars have been made for more than 100 years, Kor wants to print his cars.

It's not a gimmick. He says the only way he can create the Urbee body is with 3D printers, which create objects that are impossible with conventional manufacturing.

For instance, instead of using sheet metal with a uniform thickness, he can create large, intricate pieces that vary in thickness as needed to strengthen and lighten the car.

He compared it to the way nature has designed the bones of birds -- they are extremely lightweight yet strong, without a smidge of extra

material.

"The process has the potential to put the material exactly where you want it and not put it where you don't want it," he said. "Conventional cars carry around a lot of extra weight."

Size no factor

The capabilities of 3D printing also freed Kor to radically rethink the car's design: His Urbee will be made using only about 50 large pieces, some of which are deceptively intricate.

Take the bumper. RedEye had one incubating last week inside one of its top-of-the-line Fortus printers made by Stratasys, a maker of 3D printers and RedEye's parent.

From the outside, it looks any bumper, but inside, Kor included ductwork for both the dashboard and the rest of the car.

The ability to print out a bumper with ductwork allowed Kor to attach the windshield and dash directly to the bumper, which helped make it more aerodynamic than a Toyota Prius, with half the weight and rolling resistance, he said.

It also eliminated parts. Lots of parts.

"Take a car apart and put all the parts on the floor," Kor suggested. "For just the dashboard, there must be thousands!"

Using the unique capabilities of 3D printing, you can make a lot of those tiny individual parts into one part unified piece, he said. The Urbee's car body will be assembled from about 50 separate parts, total.

"The surprise to us is that there are very few car parts in this. We didn't start out that way," Kor said.

Designing a printed-out car may initially be more expensive, but it could become an advantage if large-scale production gets under way, Kor said.

The technology of 3D printing continues to get better and less expensive, he said. The cost of printing out a relative handful of parts eventually could drop below the cost of manufacturing requiring thousands of individual parts be made and then assembled, he said.

Three-dimensional printing opens up the vision of the designer, said Jeff Hanson, business development manager for RedEye.

What you can make -- and how you make it -- is limited only by your imagination, he said.

Hanson envisions not a single printer producing a car part by part but a factory filled with 3D printers. The factory can be automated so that parts can be moved from the printers to an assembly line.

The Urbee is the largest project RedEye has tackled to date, but some visionaries in the field of 3D printing think it can be used to make buildings, even a moon base one day.

"Size is not an issue," Hanson said. "It's budget. You could print an aircraft carrier if you had the budget."

A plastics bakery

If there ever is a car-printer factory, it might look, sound -- and smell -- a lot like the RedEye production floor.

Inside a cavernous room with exposed ductwork high

overhead sit 88 3D printers, each about the size of a mainframe computer -- or, if you're domestically inclined, a very large double-door refrigerator.

The machines all come with windows. Through the window of a Fortus 900mc making the Urbee bumper, for in-



A control panel on the exterior of a "fused deposition modelling" printer is checked during the 3D "printing" of the thermoplastic front right bumper of a full-size car. (Pioneer Press: Richard Marshall)



"In a way, this is how we humans grow. One molecule at a time added onto the rest," said inventor and designer Jim Kor of Winnipeg, Manitoba, showing off a 1/6th-scale model of Urbee 1. (Pioneer Press: Richard Marshall)

stance, a nozzle is spraying a red polymer on the nearly finished product.

The process, called fused deposition modeling, applies microscopically thin layers of plastic. Each layer bonds to the previous layer in an oven-like container that, in the bumper's case, must be held at a constant 90 degrees Celsius, or 194 degrees F.

Every 30 seconds, air dryers in the room exhale with a sharp hiss. It sounds like the breathing of a giant machine with sleep apnea.

The room is quiet and warm, and the air holds the tang of toasted plastic. It's not unlike be-

ing in a bakery if the bakery were making bread out of plastic cups and soda bottles instead of dough.

RedEye works on a variety of projects for companies and the government, which requires security clearances for anyone entering the room. But clients rarely visit.

Instead, they log on to the business' website and download their designs, said Noah Zehringer, a senior applications engineer for Stratasys. He ramrodded the Urbee project.

"Once I enter the data and push play, I don't have to do anything more," he said.

"We call it 'lights out' manufacturing," Hanson chimed in. As in, push the button, turn out the lights and go home. The machine takes care of the rest.

Two employees staff the production floor in three shifts around the clock. They make sure the product gets removed once the job is completed, a new design is downloaded, and the right amount of material is loaded.

Then they push the start button again.

Machine reproduction

Some rush-job prototypes of small items can be done overnight. Others are what the engineers call a "weekender," taking a few days.

The Urbee bumper, which is made in two pieces, required 300 hours to finish, or 150 hours for each half, Zehringer said.

Printing the whole car should take 2,500 hours.

"It's all about integrating as many parts as possible into one part to make it as efficient as possible," Zehringer said.

Zehringer delights in showing off another feature of 3D printing: He holds up a plastic control panel bezel for a Fortus machine made by the machine itself.

The printer can do the same thing for some of its handles, light towers and a few other parts, he said.

Yes, it's what you think. The machines have a limited form of reproduction.

Kor, through his company Kor EcoLogic, is aiming right now just to make one car. As soon as it is ready, he and a partner are going to take it on a cross-country trip from San Francisco to New York City.

The idea is not just to prove the three-wheeled hybrid can make the trip, hitting top speeds of 70 mph, but that it can do it on only 10 gallons of gas -- one tankful. Ideally, he'd like to use pure ethanol.

The Urbee hasn't been priced yet, but Kor envisions it as an economy car, maybe for cash-strapped college students. So far, he has orders for 14 Urbees, most of them from people involved in designing it.

"I envision it will be like a Model-T or VW (Bug) for our century," the inventor said.

There will be one extra passenger on that cross-country trip: Kor said his dog will sit behind the driver and passenger in a rumble-seat-like space.

"When I designed this, it wasn't going to be an exotic car. It started as a more personal thing.

"It had to fit my dog."

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