

## NEWS

# Ingenuity to go: WPI student creates mobile lab out of school bus



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WORCESTER — Parked on Dover Street, just across from Alumni Stadium at Worcester Polytechnic Institute's campus, Jeremy Trilling's "Tool Bus" could be easily overlooked as any other yellow school bus just from its outward appearance.

The unassuming vehicle is actually a \$100,000 lab on wheels that Trilling, a senior studying robotics engineering at the university, spent 10 months putting together with the help of friends.

"I think always having the physical space to build things is a necessity and having to, as a student, transition between workspaces and not have a sort of permanent dedicated space was definitely raising the activation energy that it required for me and my friends to make stuff," Trilling said. "Really streamlining that process of hanging out and being able to do useful and fun things was the impetus for it."

He said he looked into different options, such as renting spaces, getting a shipping container or semitruck.

Trilling eventually landed on transforming a bus into an engineering space after a friend decided to turn a bus into a diner, he said.

"A friend of mine purchased one of these style buses, an autonomous HDX bus and so I got to tour that space that he was working on," he said. "I said, 'Wow, the windows are awesome, the whole space is excellent, the ceiling heights are great' and so from there, I said this is probably a nice venue to set up all of the stuff."

Trilling said he began searching and came across the future tool bus on Facebook Marketplace.

After purchasing the bus for \$5,000, he said that he and his friends spent time thinking through the design of the inside of the bus.

## Solar panels on outside

They took out the original bus seating and repainted the inside, added wiring and outlets and attached solar panels to the roof of the vehicle.

The bus stations are divided by a path splitting it down the middle and are organized in a way that allows them to naturally flow into each other.

"It had many different iterations of layout but we converged on this sort of nice aisle and put in the nice flooring," Trilling said. "One of the biggest things was putting in all of the outlets and finishing that whole solar setup ... that was only completed fairly recently with the help of a lot of friends from here at WPI."

The tool bus may require gasoline to drive but the solar panels give the different work stations inside power. Underneath the bus, hidden behind panel doors, are batteries, which Trilling said can power the bus for up to 10 days without sunlight.

"Running Romex cables through the ceiling and through all these glands so you can plug in all their stuff, that was a big thick job," he said.

At the front near the driver's seat is his digital design station, which is located directly across from his 3D and 2D printing station where the designs are converted. Toward the back of the bus is his manual lathe and mill combination, which is located directly next to his welding station.

The tool bus also has a mechanical workbench, an electrical workbench, a large-format laser cutter, a CNC mill and a large-format CNC router.

He has also taken safety into consideration by having safety equipment, such as protective eyewear, in abundance as well as nonflammable argon gas for welding and fire extinguishers "just in case."

## **No stranger to working with vehicles**

Trilling had been working with vehicles and renewable energy sources since before arriving at WPI.

Born in Palo Alto, California, the heart of Silicon Valley, he said he became interested in engineering after he fractured his spine in middle school.

"What I did was create a lot of small electric vehicles that assisted in my daily commute because that was sort of a pain point that initially began with me fracturing my spine in middle school through just repetitive stress, volleyball and gymnastics and all that stuff," Trilling said.

Another of his inventions that he developed before arriving at WPI was an electric-powered, flying personal vehicle he calls the Pumpkin Carriage.

"I had lots of awesome mentors who were in this electric vehicle space," Trilling said. "The concept of flying around and still having those same fun experiences was really appealing."

The Pumpkin Carriage, which is strapped to the back of the tool bus, weighs about 150 pounds and can fly for about 10 minutes at up to 18,000 feet legally using a propeller and paragliding wings system.

"It turns out that if your aircraft weighs less than 254 pounds without a person, you're able to fly it without a pilot's license," he said.

Trilling began honing his craft in high school and also co-started a student-run makerspace known as MakeX.

"It's been turned over to the next generation of leaders," he said. "That was definitely a space where friends could build stuff and teach each other how to do things and so that kind of mentality is what I attempted to recreate in this space," he said of the tool bus.

Trilling chose to attend WPI because of the school's pedagogy, he said.

"The hands-on learning and access to machines and close relationships with professors was appealing to me," he said. "I was looking for a small school where I could have the creative freedom to build and do stuff that's fun."

## **Jobs in robotics, engineering**

Now 22 and in his final year at WPI, Trilling has already had several jobs in robotics and engineering.

One of those jobs includes helping develop electric helicopters at Beta Technologies in Burlington.

"I had lots of awesome mentors who were in this electric vehicle space," he said. "The concept of flying around and still having those same fun experiences was really appealing."

Although he didn't need a license to fly the Pumpkin Carriage, he was able to get his helicopter license while working at Beta, where he continues to work part time.

"I've been able to fly their aircraft as well and that really helped inform how to design the same kind of helicopters I was flying but with an electric propulsion system instead," Trilling said. "Using that same kind of experience from all the helicopter knowledge gained from that whole certification process is something I'm excited to apply to these sorts of smaller, autonomous systems."

## **Project on land-mine disposal**

Trilling said the bus was "sort of the enabling technology for the senior project," which focuses on a process known as demining.

"There's a lot of land mines that are left in war zones," he said. "Being able to detect and safely dispose of land mines is a big challenge and so there's some awesome new stuff with ground-penetrating radar that can sense where these locations are but then disposing of them safely is the next step."

At the very back of the bus, sitting on top of the CNC router, is a metal frame that has snowboard bindings attached to the top and a rotor head system on the sides.

This is part of Trilling's senior project, which he describes as a hoverboard.

"It's sort of a two-part system — you have the large heavy-lifting drone, which that thing is. That then navigates and can sort of locate where the land mines are using the sensors and then the large vehicle drops a separate aircraft," Trilling said.

The second separate aircraft would be deployed to be able to accurately descend upon the landmine and cause it to detonate.

The point, he said, is to be able to locate and detonate the land mines safely without having to involve humans.

The snowboard bindings on the top of the heavy-lifting drone are "more of a fun thing for a separate application," he said.

## **Antithesis of Silicon Valley**

In some ways, Trilling's engineering philosophy is the antithesis of Silicon Valley in that he wants to create affordable technology that uses renewable energy and is environmentally safe.

"Creating systems that can allow for long-term low-energy flight has been very appealing," he said. "This flying car (Pumpkin Carriage) was able to fly for about 10 to 15 minutes, which is nice but not really useful for sort of recreational use and so the next thought is, 'OK, how can I stay up there for longer?' "

He is interested in finding a way to safely use hydrogen as a lifting gas as opposed to helium as it "can be split from water and electricity.

"Helium is also great. It's just a little expensive and harder to come by nowadays, supply shortages and stuff," he said.

Trilling said he will finish at WPI in December and that he plans to work afterward rather than pursue a graduate degree.

He has an outstanding offer at Beta Technologies and will likely move to Burlington after graduation, he said.

"I like building stuff," Trilling said. "I think the eventual goal for me is to create cargo airships and flying tiny homes."