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Table of Contents

Robotics Trends
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Robotics Trends

The business guide for professionals who use, manage, or create robots and intelligent systems

Personal Rapid Transit—Where the Robot Meets the Road

They're fast, flexible, driverless, and in control—and they may provide tomorrow's perfect commuting solution.

By John Edwards

Picture this scene next time you're caught in a morning commute traffic jam. Sometime in the not-to-distant future, you make the short walk from your home in the outer suburbs to a nearby "pod station," a raised platform somewhat larger than a street-side bus shelter. Press an app button on your smartphone, and a few moments later an aircraft-shaped suspended car, looking like a Euro-designed ski gondola, glides to a halt at your feet. Enter the car, use the touchpad to give it your destination, and a few seconds later you ascend what you might describe as the monorail equivalent of a highway on-ramp, connecting you to a main, high-speed artery. There, you join thousands of other commuters like yourself traveling at 150 miles per hour, while each is cocooned within the pleasant quiet of their own pods. You're free to read, catch up on work, or simply enjoy the smooth, silent ride. Upon arrival downtown, the car exits the high-speed artery via an off-ramp to a pod station near your destination.

That vision comes from a company called Unimodal Systems LLC, developer of the SkyTran personal rapid transit (PRT) system, a network of suspended rails able to ferry people in the comfort of a private, pod-like vehicle throughout a metropolitan area. Unimodal claims SkyTran will revolutionize "the economics of public transportation," because it's able to operate at a profit and without tax subsidies or financing, and since it costs significantly less than the light-rail commuter-train systems some urban planners envision. Yet it can carry as many people to their destination each day as a multimillion-dollar six-lane highway.

Unimodal, which is based at NASA's Ames Research Center in Silicon Valley, uses software originally developed by the space agency to control robots and other applications, revealing just one of the robotics applications that would be needed if large-scale autonomous transportation systems were built. Other likely robotic technology needs would include sensors, intelligent route-planning systems, motion control

Continued on next page

The ULTra PRT system at London's Heathrow Airport. (Photo courtesy ULTra PRT.)

The SkyTran personal rapid transit (PRT) system is a network of suspended rails able to ferry people in the comfort of a private, pod-like vehicle throughout a metropolitan area.

and safety monitoring software, as well as motors able to provide jar-free stops and starts.

In fact, Unimodal is but one of a growing number of companies worldwide with PRT designs they claim are ready to implement. Meanwhile, cities in the United Arab Emirates, Korea, and the United Kingdom are among those with plans to install such systems in the next few years, while several systems, such as the 13.2-kilometer track in Morgantown, W.V., have already begun operations. All of which suggests that PRT systems could represent a major market for robotics companies.

Little wonder. With most of the world's major cities held hostage to gridlock and taxpayer reluctance to finance large infrastructure projects, PRT systems represent an extremely enticing alternative. These small autonomous vehicles, sometimes described as pods, are designed to ride on their own special tracks, much like present-day airport trams, or else tailgate each other along existing roads. Such systems appear all the more attractive when you consider commuters' reluctance to use traditional mass transit systems, the push for greener commuting alternatives, and the rising expense of fuels.

Jeremy Carlson, advanced driver assistance systems analyst for iSuppli Corp., a technology research firm located in El Segundo, Calif., believes that commuter pods could eventually become an everyday reality, but acknowledges that plenty of work remains to be done. "It's not still experimental at this point, but there's a lot of research and development that continues to go into it," he says. "In some respects, they're quite practical."

Disney's Dream

In fact, the autonomous vehicle/commuter pod concept has been kicking around for several decades. One of the earliest and most famous proponents was Walt Disney, who fancied

himself as much a technology visionary as a cartoon animator. In the 1960s, joining urban transportation experts, Disney endorsed a concept known as the "people mover," as a way of efficiently moving large numbers of people in congested environments, while preserving as much personal transportation flexibility as possible.

Disney's support led to the installation of demonstration people-mover systems at Disneyland and Disney World. The first system debuted at Disneyland in 1967; the Disney World system continued in operation until the mid-1990s. Indeed, the WEDway PeopleMover (WED representing the initials of Walter Elias Disney) featured four-pod "trains" that used onboard linear-induction motors working in conjunction with powerful electromagnets embedded in the track. The magnets provided linear motion by switching on and off in sequence. As a vehicle approached, the magnet would switch on to create a magnetic field that activated the motor, which would spin a set of rubber wheels to push the vehicle forward smoothly and virtually silently. From a passenger perspective, the PeopleMover provided push-button convenience. If a train was not already available as you entered the station, pressing a button would signal the control system to quickly send one.

Despite the efforts of Disney and colleagues to sell the PeopleMover concept to cities and other potential adopters, the technology never achieved widespread acceptance—mostly due to high start-up costs, including the expense of building tracks through congested urban areas.

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Fast Forward

Modern PRT system designers believe these obstacles can be overcome using suspended tracks, as originally conceived for monorails, or by making more efficient use of current roadways; for example, creating special PRT lanes or lanes reserved for autonomous vehicles.

One British company has devised a modern take on Disney's people-mover concept. ULTra PRT, based in Bristol, England, thinks it can overcome the cost obstacles that derailed previous people-mover initiatives by using a cheaper concrete guideway rather than an expensive powered track. "The best way to describe this is as a sidewalk that happens to have a bigger curb," says Fraser Brown, ULTra PRT's managing director. "The track does not have any high-voltage electricity; it doesn't have a rail in it."

One of the earliest and most famous proponents of the autonomous vehicle/commuter pod concept was Walt Disney.

Unlike Disney-type people movers, which drew power via induction from magnets located along the track, ULTra PRT's technology relies on self-powered passenger pods. "The vehicle has got its power onboard, the same way an electric Nissan LEAF or a Tesla [electric car] would," Brown says.

ULTra PRT is currently operating a demonstration system at London's Heathrow Airport that features individual pods containing a pair of bench seats capable of carrying four to six passengers. There's also space inside each pod for other items, such as bags, carts, and luggage. The pods shuttle passengers between a car-park and the terminal on a route that was previously served by two 50-seat buses. The buses, which ran on a four-times-an-hour schedule, needed about six or seven minutes to move between the locations. Travelers could wait up to 10 minutes for a bus. "What we've done is replace that system with 21 vehicles," Brown says. "Typically, a customer doesn't wait at all."

Since the pods run along dedicated guideways rather than on public roads, ULTra PRT has been able to use existing navigation and safety technologies. Lasers and sensors

keep the vehicles on course. "We've also got failsafe systems, similar to a railway system," Brown says. "So if you have a vehicle ahead that slows down for any reason, then other vehicles won't get too close to it."

Rider comfort is akin to sitting inside a taxi or limousine with one important exception: virtually no noise. "It's a very quiet journey, because the vehicle is running on an electric motor, so you don't have the noise you would have from an internal combustion engine," Brown says. "The experience is quite plush and business-class like."

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The Auto Alternative

As efficient and comfortable as the ULTra PRT sounds, it still requires special infrastructure. Moreover, the U.K. design and others like it must overcome what could be PRT's biggest obstacle of all: people's reluctance to give up their own personal vehicles. That is why some designers foresee systems in which conventional cars and trucks are rigged to operate either semi-autonomously or with full autonomy on existing roads.

While autonomous vehicle research has gone on for a very long time, only in the past few years have computers and related systems become small and powerful enough to begin tackling the challenge of rapidly detecting and responding to a continuously changing on-the-road environment with anything close to 100 percent accuracy. "If you want your car to navigate by itself, it has to know where the road is, where the signs are, and where everyone else is," observes Eugenio Culurciello, an associate professor of biomedical engineering at Purdue University in West Lafayette, Ind. Culurciello leads one of several research teams worldwide developing the complex algorithms that help prevent autonomous vehicles from running into things. "Right now, we can detect about 20 categories of objects—meaning a car, a pedestrian, a bicycle, a street sign, buildings, road, sky," he says. "This is the starting point of our system, and we are training it to improve the precision."

Nearly all major car and truck manufacturers, as well as numerous university and tech industry research labs (including Google), are working on the problem. Sweden's Volvo, for example, is developing self-driving vehicles for the EU-sponsored SARTRE (Safe Road Trains for the Environment) research project that's examining the use of multiple vehicle convoys for long-distance travel. Such convoys promise to eliminate a lot of the navigation and collision avoidance issues that have plagued many fully autonomous vehicle projects. According to SARTRE, a lead vehicle with a professional driver will take responsibility for a convoy. Following vehicles will enter a semi-autonomous control mode that allows drivers in those vehicles to do other things that would normally be impossible for safety reasons, such as reading a book, watching a movie, or catching a few extra winks.

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"You can engage in secondary activities ... that's the vision," says Stefan Solyom, an autonomous drive technical specialist at Volvo in Gothenburg, Sweden. Convoy rides should also be cheaper than conventional commutes, thanks to the potential for substantial fuel savings. "If you're following a vehicle at one vehicle-length's distance, which can be as small as 5 or 6 meters at around 90 kilometers an hour, then you will get a fuel reduction of around 15 percent," Solyom says. "That's quite a big number, and it is worth looking at."

The first convoy tests are already under way. Earlier this year, a Volvo truck, driven by a professional driver, guided a Volvo S60 around a country road test track without any input from the car's driver. "It is hoped the project will eventually lead to large convoys of autonomous vehicles all traveling at high speeds and close distances to reduce accidents and save fuel," Solyom says.

Inside one of ULTra PRT's pods: Comfort is akin to riding in a limo—only quieter, thanks to the electric motors propelling each unit. (Photo courtesy ULTra PRT.)

Roadblocks

Needless to say, high hurdles must be overcome before swarms of robotic vehicles ply our streets *sans* drivers. That is, autonomous vehicles on public roadways must navigate through a world fraught with an ever-changing array of stationary and moving obstacles. "In autonomous driving, there are a lot of things that go into it and a lot of things you need to pay attention to around the vehicle and in the vehicle as well," Carlson explains.

Several important legal and regulatory issues will also need to be resolved before driverless vehicles begin roaming public roads. Accident liability looms as a major concern. Negligence attorneys already make a tidy sum representing clients who blame vehicle and roadway deficiencies for injuries and deaths. Many autonomous vehicles proponents feel that the deployment of driverless vehicles could be delayed, perhaps for many years, by manufacturers fearful of facing a sudden onslaught of new lawsuits.

Meanwhile, if the public appears captivated by the PRT concept, and if the private financial markets or government entities can devise ways to finance them, pod systems are technologically ready for takeoff, maybe in a city near you. RT

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