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Drive On – E-Bikes Shift into High Gear

HP's mobile workstations give a small developer of electric bicycles the flexibility it needs to compete with bigger companies.

HP Workstation Value Proposition

HP computers are used in nearly every job today. But particularly in designing products or in mission-critical applications, HP Z Workstations, powered by Intel® Xeon® processors, play an important role.

As the market leader in this segment of computing products, HP has dedicated engineering teams that develop the products, integrate them, and manufacture them. HP ships more workstations than any competitor, and in EMEA (Europe, Middle East, and Africa), HP has shipped the most workstations since 2006.

The three main components HP focuses on when developing products are innovation, performance, and reliability. There are many innovations HP has brought to the market first. One example is the tool-less chassis design. Without any tools, the components of the system can be exchanged, upgraded, or serviced. DreamColor technology is a color-matching tech-

nology brought to market by HP. Another technology is remote graphics software that can be used to control a computer over a network connection in a very elegant way.

The second topic important to workstations is performance, and of course, HP uses the latest components from partners such as Intel to design those systems. These components are integrated into what HP calls whole system engineering design. HP controls the firmware and everything that goes into the computer to provide the maximum performance to the user, whether in high computing environments or in highly graphics-intensive applications.

The third topic is reliability – mission-critical systems controlling equipment far away. HP tests products under very rigorous conditions. HP mobile workstations are tested according to military standards.

If the five childhood friends and co-founders of electric bicycle developer FAZUA GmbH in Munich, Germany have their way, Europe's fast-growing e-bike market soon will shift into an even higher gear.

Venture-funded FAZUA is using HP Zbook 15 mobile workstations, powered by Intel® Core™ processors, and SolidWorks 3D modeling software to develop an innovative drive system for pedelecs, which are bicycles where the rider's pedaling is assisted by a low-power electric motor that shuts off when the rider stops pedaling.

The vast majority of electric bicycles are pedelecs, and Europe has taken to them with great enthusiasm. For example, in 2013 there were some 410,000 electric bicycles on the road in Germany – more than twice as many as in 2010 – and 1.2 million in use throughout Europe, according to the German Bicycle Industry Association (the Zweirad-Industrie-Verband).

Pedelecs are increasingly used for everyday commuting as well as for sport riding and leisure touring. They enable commuters to expend less effort and to show up at work fresh, and they allow people who lack strength and endurance – such as older people



FAZUA's patented evation electric drive system is compact, lightweight, and removable. Its components blend into the bicycle frame and are all but invisible except on close inspection. (Photo by Stefan Schmalzgruber)



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or those recovering from injuries – to enjoy the health and recreational benefits cycling can provide.

Pedelecs differ from higher-powered pedal-assist bicycles and fully electric units in that they are regarded as conventional bicycles and not mopeds, which may require a driver's license, registration, and insurance.

Lightening the Load

FAZUA's patented evation electric drive system is not only compact, lightweight, and removable, but unlike all other pedelec drive systems, its components blend into the bicycle frame and are all but invisible except on close inspection. evation eliminates the bulky, heavy, and unsightly drive components of other systems, which detract from what are otherwise sleek and stylish bicycles.

According to FAZUA Co-Managing Director, Marcus Schlüter, the idea for such a product came to co-founder Johannes Biechele when he was an automotive engineering student at the University of Applied Sciences Munich. He worked part-time at a company that made e-bike drive units that were big and heavy. As an avid mountain-biker, e-bikes intrigued Biechele, but he told Schlüter and the other friends now at FAZUA – all automotive engineering or business students at the time – that he would never think of buying a bike with such a heavy, obtrusive, and unattractive pedal-assist system.

That experience triggered the desire to design a lightweight, compact system that could be built into the downtube of a bicycle frame. The university provided initial startup funding to pursue the idea, and early in 2014, the fledgling company obtained seed funding from two venture-capital funds to accelerate product development and position itself for market entry in 2015.

Schlüter said the only computers the FAZUA team uses are the HP Zbook 15 mobile workstations, powered by Intel® Core™ processors. "As a very small company, the HP Zbooks give us tremendous power and flexibility. We use them at the office, at home, in meetings, wherever we need to be at a given moment, with no limitations of any kind. In fact, we have no other computers. Everyone uses a split screen, which enables us to have a regular desktop as well as the CAD (computer-aided design) and other technical files. This flexibility helps us take advantage of the fact we are long-time friends who know each other's strengths and weaknesses, and enables us to work in deep col-



A removable "engine pack" mounted on the downtube contains the motor, battery, and control electronics. (Photo by Stefan Schmalzgruber)

laboration without boundaries, no matter what the day's tasks happen to be."

Schlüter also said one unexpected benefit of the HP Zbook 15 mobile workstations, powered by Intel® Core™ processors, is that their docking station is the best he's ever seen. "It may seem a small point, but with the computers we've used in the past, the docking stations were often a point of frustration. Fast time-to-market is critical to survival for small companies like ours. When simple things like docking stations don't work properly, and you have to spend valuable time dealing with whatever issue has arisen and must restart the operating system each time, it is incredibly frustrating."

Driving Design

The HP mobile workstations, powered by Intel® Core™ processors, have been an invaluable tool in driving the current design, which features a gear system, or transmission, mounted in the bottom bracket of the bike frame and a removable "engine pack" mounted on the downtube containing the motor, battery, and control electronics.

The initial concept was to find the smallest drive components possible and then fit them all into the downtube, but Schlüter said, "We realized we would want the ability to remove these components so that we could, for example, bring the unit inside at night to charge the battery. The solution was to separate the transmission from the other components, and put it in the bottom bracket."



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A driveshaft connector with a precisely designed polygon profile connects the motor and transmission in the evation design. One end of the drive packet slips into it with a simple click. (Photo by Stefan Schmalzgruber)

The transmission is a conventional angular gear system modified to fit into the bottom bracket, along with an integrated torque sensor to measure how hard the rider is pushing on the pedals. The angular gear makes it possible to take the power generated by the electric motor and turn it 90 degrees to drive the chain sprocket wheel.

Without a secure and highly efficient connection between the motor and the transmission, it would be impractical to separate the two. A driveshaft connector with a precisely designed polygon profile does the trick in the evation design. One end of the drive packet slips into it with a simple click.

The drive packet weighs 3.7 kg and the goal is to get to 3 kg, Schlüter said. The lithium ion (Li-ion) battery features cells 18 x

65 mm long, and has a 240 Watt-hour capacity. This is enough energy to drive the brushless dc motor for a day of touring, he said.

A switch on a small interface display mounted on the handlebar turns the system on and off, and the rider can select from three levels of electric assist, ranging from an eco-touring mode with minimal pedal assist, to a sport mode that provides a boost equivalent to 200 percent of the rider's pedal pressure.

Schlüter said the HP Zbook 15 mobile workstations, powered by Intel® Core™ processors, are a great tool for modeling the evation system to analyze the mechanical strength of the transmission components and the polygon connector, and to reduce the overall weight and size of the drive packet. "The ability to predict transmission component breakage, and where it might occur, is vital to the development of the evation system. The HP workstations allow us to exploit all of the capabilities of SolidWorks with no degradation in speed, no matter how complex the data files are."

It's interesting to note that the company's name, FAZUA, comes from the Bavarian expression "Fahr' zua," meaning to go ahead, or to drive on. But in this case, it's not only a name; it's also an apt description of the young company, which HP's Zbook 15 mobile workstations, powered by Intel® Core™ processors, are helping to propel forward.

Learn more about FAZUA technology at
www.fazua.com

Find out how HP workstations can power your business at
www.hp.com/eu/workstations