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THE FAHRRADBUS PROJECT

The Fahrradbus is a modular, articulated human-powered recumbent tricycle for several riders. The configuration gives synergetic advantages over a single-rider machine. Philipp Köder made contact with *Velo Vision* to explain all.

BACKGROUND

The idea to build a human-powered, multi-person vehicle was born during a brainstorm session at a Young Friends of the Earth meeting in Stuttgart in January 2013. The first aim was political rather than to invent a practical bicycle design, but we wanted to show that a group of more or less laypeople can build a futuristic HPV. We asked ourselves, "What is possible?" and imagined what sort of transport solutions could be invented by corporations like big automobile companies combined with the know-how and creativity of universities, if they would apply themselves to sustainable transport.

First, drawings and concepts evolved on paper, and existing HPV concepts were examined and critiqued. Early influences were the Hase Kettwiesel in the 'road-train' formation, the Twike (side by side faired e-trike), the Lizzy, and the Trampelwurm, a project we learned about afterwards. In early 2014, our construction plan was complete but ended up in the drawer because the money wasn't available for implementation.

Fortunately, the situation changed by accident when the Young Friends of the Earth met a group who call themselves Uniexperiment (www.uniexperiment.de). Self-educated and running their own educational establishment, this group had similar ideas and thoughts about modular multi-person vehicles. They brought to the project the necessary courage and know-how to raise money and realise the Fahrradbus.

Soon, things got on the move – material was bought, a workshop was organised, and, in October 2014, we built the prototype with about six people in six days – in time for a maiden voyage in November 2014. The second Fahrradbus, built in Berlin in July 2015 by the Wanderuni (www.wanderuni.de), another educational group, comprised another three modules and was completed in ten days, including the paint!

IMPLEMENTATION

The Fahrradbus consists of identically constructed modules, each for two people, connected together with couplings. The result is a multi-person 'sociable' HPV that tracks easily round obstacles and features particularly good ergonomic and aerodynamic properties. Within each module, each person drives their own wheel with hub gear and selects a gear ratio to suit, allowing each rider to pedal at their own pace. The left-seated

Basic concept:

Multiperson-bicycle: Synergetic effects, FUN!

Modular and flexible, allowing a number of modules to connect together as a train, or ride independently as a single unit.

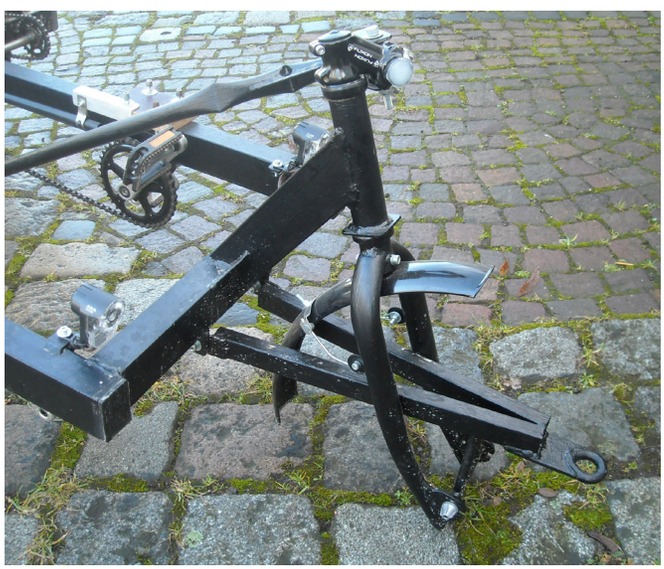
Multitrack configuration is stable, safer in all weather conditions, and easier to ride very slowly.

Riders benefit from the recumbent position: a good all-round view, ergonomics, and aerodynamics.

Potential to be equipped as a Velomobile, offering weather protection and aerodynamic efficiency.

Low-Tech: From the beginning of the design, the philosophy of the Fahrradbus includes the low-tech principle. The use of simple interchangeable fabrications creates a rugged and repairable machine.

BELOW: Steering rider (closest) has twin brakes. The outside bars with the gear shifters are fixed.

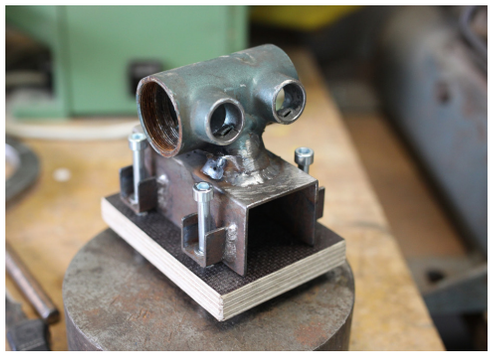


rider controls both steering and braking. Steering is controlled by a single centre-stick – the outer handlebars are fixed.

Each module in the Fahrradbus has the capability to be driven individually or as part of the train. For running in 'trailer-mode', a drawbar is used to connect each vehicle, rather than using the front fork dropouts directly. A bar is clamped in the fork, locking the steering, then a towing eye on the bar locates in a simple hitch on the back of the leading vehicle. Independent hydraulic rim brakes are always operative, whether a module is part of the train or running independently. The simple transition to 'solo mode' requires the removal of the drawbar with two quick releases and refitting the front wheel, previously stored behind the rider's seat.

In terms of cargo, the space behind and to the sides of the riders, forms a large and versatile luggage space by the use of a net strung across the frame between the enclosed wheel boxes. More space is possible if the seats and the centre-stick are removed, converting the module into a load trailer with capacity greater than the size of a euro-pallet – drawn by the power of the riders ahead in the train.

We believe there are several parts of the design that make each Fahrradbus likely to have a long and productive service life. The frame is deliberately adaptable, allowing easy implementation of additions and changes. Adjustability is designed into the frame, with features like adjustable seats and bottom bracket. Repairability is heightened as we used conventional bike parts wherever possible



(with the exception of the jackshafts).

The frame construction is deliberately simple, made in a single plane from box-section steel tubes. Most of the welding was done on a flat surface and we had no need for a frame jig during manufacture. More simplicity results from the choice to run 26" wheels with balloon tires, saving the need for a technically challenging suspension.

We hope to keep maintenance low by the use of hub gears built into strong wheels covered over by wooden wheelhouses. These are important for the vertical parking position, and they keep the transmission cleaner and drier, too.

SPECIFICATION

Length: ..... 2.43 m (1 module),
..... 6.91 m (3 modules)

Width: ..... 1.35 m

Height: ..... 1.01 m

Weight: ..... 60 kg

Turning circle: ..... 5.5 m (3 modules)

SOCIABLE EXPERIENCE

The first short test drive with two modules took place on 31st of October 2014 after five long days and nights working on the prototype. We rode to Wernau, a small town near Stuttgart. It was fantastic! It worked! We felt like genuine inventors on our rolling heap of square tubes, augmented with bits of bolted-on scrap plywood. It was nighttime and we had no taillights. Plus, as we were wearing pilot goggles for fun, we made a most unusual spectacle. Unsurprisingly, we were stopped by two police officers on the main street in the town. Only curious, their restrained smiles said it all. We explained it was the historic first ride of the so-called "Fahrradbus" and added some assurances we would fit some taillights to it later.

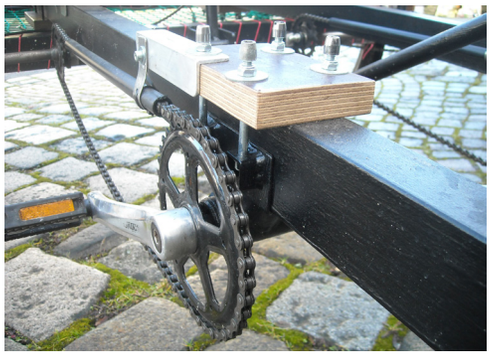
So far, we have participated in some critical mass rides, action days, and demonstrations. We have found some other practical uses, too. We have tried lending the Fahrradbus to groups for holidays, completed a house-move, presented the design to many people, including test rides, and we've done a lot of leisure rides and utility journeys. Overall, the Fahrradbus has been used more for fun than for daily use.

Feedback on the Fahrradbus is highly complimentary, riders saying they greatly appreciate how the eyes, hands, and ears are free for conversation with neighbours. Riders get a lot public attention, but we can count negative feedback on one hand. Even car drivers usually react with a smile or a thumbs-up and it's not rare for passersby to cheer and break into applause. We enjoy that aspect of riding the Fahrradbus.

So far the full cargo capability of the Fahrradbus remains untested, as the Shimano Nexus 8-speed hub does not provide the necessary gear ratios. The biggest load we managed to haul was a single module loaded with furniture for a house move across Stuttgart, where two people pulled the third cargo module.

In consistent feedback from riders, they say the Fahrradbus is more than cycling. It welds the group in a special way and challenges it to act as a group, considering the needs of each individual rider. This turned out to be a positive aspect, but also a source of potential conflict. Some riders have said how it was not easy to give the responsibility to the one person that steers. Also, some riders are less willing to pedal than others and, sadly, there is no joy and delight in going uphill. Accordingly, the Fahrradbus is more slow than a normal bike, but the more we cycled with the Fahrradbus, the more we consciously slowed down and started to love cruising around with a smile.

One challenge for the riders is the combination



ABOVE: Adjustability designed in.

BELOW: Steering bar.

of a net weight of almost 30 kg per person combined with the relatively small 300% gear range. If we had more resources, we would have specified Rohloff gear hubs for each wheel (or Pinion gearboxes for each set of cranks). The ability to change gear while stationary combined with a wide gear range is essential for a recumbent-tandem like the Fahrradbus.

There may be some energy lost in the way we power and couple the Fahrradbus. We recognised an occasional oscillation of the coupled bike bus, so we used some old bicycle tubes to minimise backlash in the train. So far we haven't taken any efficiency measurements.

We have only tested a Fahrradbus with a total number of three modules. Due to safety, we recommend a maximum of three coupled modules on public roads. The reason lies in the modular braking system; each module has separate brakes and all three drivers with brakes are required to act simultaneously for an effective stop in a situation of danger. A coupled hydraulic brake system is beyond the project budget and too sophisticated, going against one of the important points of our concept.

It wouldn't be difficult to motorise the Fahrradbus in a practical, maybe semi-legal way. It would require two independent pedelec-kits (mid-drive or hub motors) per module. One important feature of the electric assist would be to 'cross' the crank sensors, ensuring the left motor responds to the rider's effort on the right cranks, and vice versa. This should have the effect of balancing the machine, and reducing or correcting torque steer, a feature that is especially noticeable when a single rider cycles uphill.

Two different groups have so far ridden long distances in Germany and Poland, each module covering between 2000 and 3000 km without considerable problems. We think this proves the DIY construction model to be a consistent and harmonious concept.

NEXT STEPS

The main aims of the project have been achieved – high manoeuvrability; a sociable side-by-side layout; and inclusivity, enabling weaker and differently-able people to ride together with more traditionally-athletic cyclists. All riders enjoy the advantages of the recumbent riding position. We offer Fahrradbus build workshops to construct three Fahrradbus modules in two weeks, for example. It's a great experience for groups to build their own special bicycle – especially with the Fahrradbus journey home to follow!

We believe there is big potential in the concept of coupled cycling. For the project to develop further, we require more resources so we invite people and companies to join us and the Fahrradbus project, so together we may improve the construction and develop special modules. Ideas circulated include, a hammock, a swing, a musician module or a workshop module containing all the tools for a mobile Fahrradbus construction workshop! There are many development ideas awaiting launch too.

We are very curious to hear your feedback, so please comment and get in touch if you have ideas or can help in any way!

Philipp Köder

www.fahrradbus.com pedalkreis.com facebook.com/fahrradbus