CAN Newsletter Online

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Model railroads and drones use CAN

Toys using CAN networks include model railroads and drones. Some of them were shown at the biggest toy tradeshow, the Spielwarenmesse in Germany.

The black Z21 comes with a CAN interface that will support the ZCAN20 protocol (Photo: Zimo)

MODEL RAILWAYS ARE FOR BOYS-AT-HEART. Especially, those models that use sophisticated communication systems to control larger model railroad systems. ESU, Gebr. Märklin, and Zimo offer three different CAN-based protocols, which are not compatible. Märklin (Germany) and ESU (Germany) use the extended frame format (29-bit identifiers). The Märklin protocol has been published, while the protocols by ESU and Zimo are not openly available. Drones are also for boys-at-heart, but professionals also use them, and not just for photo shootings. Lufthansa has signed a contract with DJI, a Chinese drone maker. These products use redundant CAN networks.

"The boy in the man"

This German proverb indicates that older men like to play with model railroads too – perhaps because their fathers didn't let them play, when the were boys. Nevertheless, this market has been decreasing for many years. Digitally controlled model railroads are complex toys. The central control unit needs to communicate with the peripherals including switch control units and brake units. Märklin started as soon as the mid of 90s with the CAN development.

The open Märklin protocol uses an 8-bit command coded in the 29-bit identifier. Other fields of the identifier include the 4-bit priority, the 1-bit respond indicator, and the 16-bit collision avoider. CAN remote frames are not allowed. The protocol can be tunneled via Ethernet. The UDP protocol message comprises four bytes to identify the message, one byte for the DLC, and the 8-byte CAN data-field. The remaining bytes are filled with "0".

Zimo (Austria) works closely with Fleischmann (Germany) and Roco (Germany). Their CAN solution uses a transmission rate of 115 kbit/s. The topology is not limited up to a length of about 300 m. For longer 6-wire ribbon cables a linear topology with termination resistors at both ends is recommended. The recommended connector is a 6-pin TelCo type connector The Z21 central controller supports the Zimo CAN protocol as well as the Märklin and the ESU application layers.

The CAN-based ECoSlink network by ESU is used for example in the Pullman model railroads. The ECoS command station supports also the above-mentioned Märklin protocol.

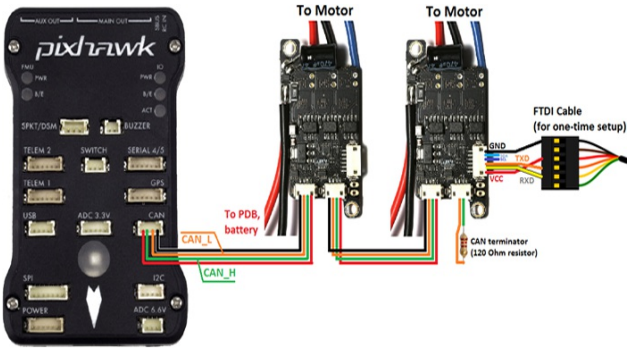
The ECoSlink terminal provides a CAN interface and is used for Pullman model railroads (Photo: ESU)

The CAN-digital-Bahn project

In order to overcome limitations of the existing CAN solutions for model railroads, the CAN-digital-Bahn project was established in 2008. It offers, for example, extensions around the MS2/CS2 control units of Märklin. This includes PC-based simulation software allowing to substitute the central control unit. The PC only needs a CAN interface. Often Peak dongles or MHS interface units (Tiny-CAN family) are used. MHS Elektronik has been a member of the CiA association since 2016. The CAN-based modules developed within the above-mentioned project include switch and feedback decoders, track control panels as well as operating devices.

Drones are for younger men

Apparently younger "boys" prefer to play with drones, also known as unmanned aerial vehicles (UAV). Taking photos from above or from other unusual viewpoints is a recent trend. An open source CAN protocol is used in drones: UAVCAN. Early adopters include APM, Danish Aviation Systems, PX4 Autopilot, Zubax, etc. Some of DJI's drones provide a CAN expansion module. The Naza-M system communicates with other DJI products (e.g. H3-2D gimbal, BTU module, iOSD mini and iOSD Mark II) via the CAN port of the NAZA PMU V2. You can plug DJI products into any spare CAN- port, since CAN ports on NAZA-M, CAN HUB, GCU, iOSD mini and iOSD Mark II are the same for the communication. If there are not enough CAN ports for additional DJI products, then a DJI CAN HUB module is recommended. The following diagram is for your connection reference.



The UAVCAN protocol is an open-source project. It supports network-wide time synchronization with a microsecond precision. Double or triple redundancy of the bus-lines is required. The pin-assignment for 9-pin Dsub connectors is compliant to CiA 303-1. Pixhawk has implemented the protocol in its CAN-connectable PX4 autopilot module running the Sapog three-phase brushless motor controller firmware. Zubax uses the open-source protocol as a primary communication interface for many of its products. The GNSS is a positioning module with double-redundant CAN interface. It comprises a GPS/GLONASS receiver, a barometer, and a three-axis compass. The UAVCAN protocol is also used for small robots.

The CAN network links the control unit with the motor units using the UAVCAN protocol (Photo: Pixhawk)

DJI

The Phantom 2 drone provides CAN connectivity (Photo: DJI)

manufacturers, offers CAN connectivity also in its Matrice 100 drone for developers. In some of DJI's drones the built-in receiver is combined with abundant output interfaces and flexible configuration, which makes the flight controller competent for complex control and airborne equipment operation; the dual CAN network design improves the data throughput and stability of the system. The important data and the non-critical data are assigned respectively on different CAN ports, which greatly improves the system stability.

DJI, which is headquartered in Shenzhen, has signed a contract with Lufthansa. The German airline said it plans to offer those interested in using drones a "one-stop UAV-shop" from aircraft operation to data analysis, insurance, and even pilot training. Lufthansa said it had already carried out a pilot project with a wind turbine manufacturer to inspect wind turbine blades using drones, while sister company Lufthansa Technik has used drones to inspect the outer surfaces of aircrafts for defects. This is far more than just playing with UAVs.