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(54) Title: INTERFACE

(57) Abstract: An interface (20), for communication between an internal device (10) and an external device (23), comprises two bus lines (CANH, CANL) of a bus for bidirectional data transfer and at least a first control line (SYNC_IN), by means of which a control signal can be transferred from the external device (23) to the internal device (10).

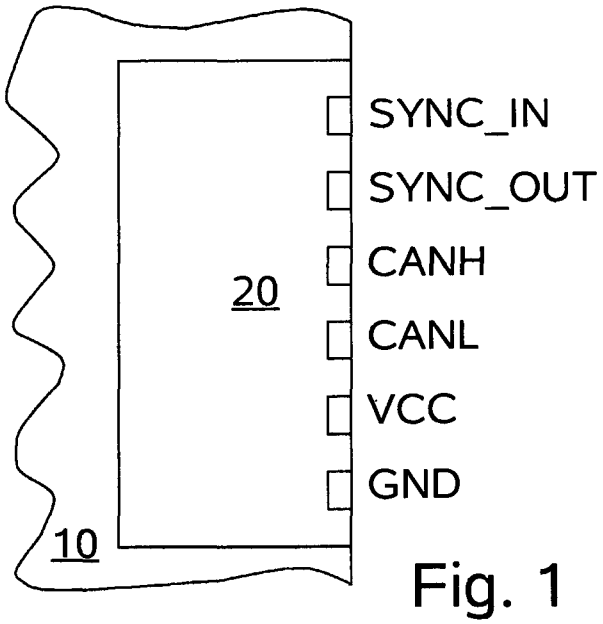

Fig. 1

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Interface

The invention relates to an interface for communication between an internal device and an external device.

By means of a laser scanner such as is known for example from US 7,430,068 B2, the surroundings of the laser scanner can be optically scanned and measured. The laser scanner can be constructed with a stationary base, for example in order to measure a closed space, or be mounted on a carriage, for example in order to measure a tunnel. In the latter case, the carriage moves through the tunnel, thus resulting in helical scanning. The data of the laser scanner are combined during evaluation with the data about the linear movement of the carriage, which are detected for example by a device which is an external device with respect to the laser scanner functioning as internal device.

The invention is based on the object of improving an interface of the type mentioned in the introduction. This object is achieved according to the invention by means of an interface comprising the features of Claim 1. The dependent claims relate to advantageous configurations.

The interface according to the invention makes it possible to synchronize the data of the internal device with the data of the external device by means of the control signals. In order not only to utilize the high speed of the control signals but also to provide the latter with greater information, the control signal is assigned an identification sequence, which is transmitted via the bus and which assigns the control signal to a specific event. It is then also unimportant whether said identification sequence is transmitted and stored at the same time or in a temporally offset manner, i.e. in preceding or succeeding (time-delayed) mode, with respect to the control signal. It is also possible to define an operation mode beforehand by means of an identification sequence passed

on the bus. In order to avoid collisions of the control signals, one respective control line per direction is preferably provided between internal device and external device, while the bus can be used bidirectionally. As the bus, a CAN bus has the advantage that the interface needs only (precisely) two bus lines. However, other bus systems (USB or the like) are also possible, if appropriate with more bus lines. A power supply and a ground in the interface permit connection of smaller external devices without a dedicated power supply.

The internal device may be a portable 3D-measuring instrument, in particular a laser scanner that can optically scan and measure its surroundings.

The external device may be any device which supplies data which are intended to be synchronized expediently with the data of the internal device. If the internal device is a laser scanner, the external device supplies supplementary data, for example non-optical data or data concerning a movement of the laser scanner.

If the laser scanner is mounted on a carriage, the external device can detect the (linear) movement of the carriage. The carriage can travel in the open or in a closed space, for example a long hall or a tunnel. In the open, the external device can be a GPS receiver. The carriage can travel on rails or on a road. Areas of application are road mapping or tunnel inspection. Thus, an inspection train can travel on a mountain section of railway line with a large number of tunnels, which inspection train travels automatically, for example, and examines the rails for fallen rocks and the tunnel walls for cracks.

The invention is explained in more detail below on the basis of an exemplary embodiment illustrated in the drawing, in which

Figure 1 shows a basic illustration of the interface,

Figure 2 shows a schematic illustration of a laser scanner mounted on a carriage, with an interface according to the invention,

Figure 3 shows a temporal sequence of a control signal on the first control line and the identification sequence of said control signal on the CAN bus, and

Figure 4 shows a temporal sequence of a control signal on the second control line and the identification sequence of said control signal on the CAN bus.

A laser scanner 10 is provided as a device for optically scanning and measuring surroundings of the laser scanner 10. The laser scanner 10 has a measuring head 12 and a base 14. The measuring head 12 is mounted on the base 14 as a unit that can be rotated about a vertical axis. The measuring head 12 has a mirror 16, which can be rotated about a horizontal axis and by means of which a laser beam is emitted into the surroundings and a reflected signal is received. Further details of the measuring head 12 are described for example in US 7,193,690 B2 and US 7,430,068 B2, the respective disclosure being incorporated by reference. The base 14 defines the stationary reference system of the laser scanner 10. An interface 20 is provided at the laser scanner 10, preferably at the base 14, which interface can be integrated into the base 14 structurally, for example.

The interface 20 serves for the communication of the laser scanner 10 as internal device with an external device 23. In addition to the hardware, the interface 20 is also assigned a communication protocol. In the exemplary embodiment, the interface 20 has six terminals, namely (precisely) two bus lines CANH (high) and CANL (low) of a CAN bus, a first control line SYNC_IN, a second control line SYNC_OUT, a power supply line VCC and a ground GND. The CAN bus is known from the automotive sector and specified correspondingly. The two bus lines CANH and CANL are used bidirectionally for data transfer. A differential data transfer is utilized in order to increase the transfer speed.

The two control lines SYNC_IN and SYNC_OUT are used unidirectionally for data transfer. On the first control line SYNC_IN, the laser scanner 10 can receive a control signal (SYNC) from the external device. On the second control line SYNC_OUT, the laser scanner 10 outputs a control signal (SYNC) to the external device. The external device, if it does not have a dedicated power supply, can be connected to the power supply line VCC (5V and up to 500 mA). The ground GND can be used not only for the power supply but also for the CAN bus and for screening. Preferably, the interface 20 at the laser scanner 10 is embodied as a socket into which the plug of a cable 25 can be inserted. The cable 25 is then inserted into a corresponding interface 20 of the external device 23 at the other end.

In accordance with one exemplary operation mode, the external device 23 passes a control signal onto the first control line SYNC_IN of the interface 20 of the laser scanner 10 at specific points in time. The laser scanner 10 passes the received control signal into its data stream in real time, whereby it is stored with said data stream. The control signal is followed (or announced) by an identification sequence which is assigned to the control signal and which the external device 23 outputs near-instantaneously (but if appropriate in time-delayed fashion) with respect to the control signal via the CAN bus CANH, CANL. The identification sequence contains the information as to what event the control signal represents. The event can be the transfer of a measured value, for example a distance, an angle or a grey level, or a status message of the external device 23. There are no restrictions in respect of this. The laser scanner 10 likewise passes the identification sequence received - if appropriate in time-delayed fashion - into its data stream - if appropriate in time-delayed fashion -, whereby it is stored with said data stream. During the evaluation of the data, it is then possible, by means of the identification sequence, for the control signal to be identified and synchronized with the data received from the measuring head 12.

The laser scanner 10 can correspondingly pass a control signal onto the second control line SYNC_OUT of the interface 20 of the laser scanner 10 at specific points in time, for example if the mirror 16 projects the laser beam towards the measuring head 12 or

if other specific positions of the measuring head 12 are attained. The external device 23 receives this control signal via the cable 25. The control signal is again followed by an identification sequence, which the laser scanner 10 outputs - if appropriate in time-delayed manner- via the CAN bus CANH, CANL. The identification sequence again contains the information as to what event the control signal represents, such that the external device 23 can identify the control signal and use it for synchronizing its data.

The operation mode described, in which the identification sequence follows the control signal, is particularly advantageous if a measurement result is intended to be forwarded near-instantaneously. An operation mode is also possible in which the identification sequence assigned to the control signal temporally precedes the control signal and announces the latter. This operation mode is particularly advantageous if the control signal is intended to be used to start an action, for example the start of a data recording. The operation mode (and hence the temporal assignment of control signals and identification sequences) can itself be defined by an identification sequence, i.e. be negotiated between the laser scanner 10 and the external device 23 (generally the bus subscribers). The negotiated operation mode could be defined beforehand for a set of events, or the identification sequence contains explanations concerning the (preceding or succeeding) control signal.

In the exemplary embodiment, the base 14 is mounted on a carriage 27, and the external device 23 serves for path detection of the carriage 27, for example by means of detection of the wheel positions. This arrangement of carriage 27 and laser scanner 10 mounted thereon is used for tunnel inspection or road mapping. The rotational movement of the measuring head 12 and the linear movement of the carriage 27 produce a helical scanning. By means of the interface 20, the data of the external device 23, that is to say the path detection of the carriage 27, and the data of the laser scanner 10 can be synchronized and if appropriate calibrated.

However, the external device 23 can also be any other device which supplies data which are intended to be synchronized expediently with the data of the laser scanner 10.

List of Reference Symbols

10	Laser scanner
12	Measuring head
14	Base
16	Mirror
20	Interface
23	External device
25	Cable
27	Carriage
CANH	CAN bus line high
CANL	CAN bus line low
SYNC_IN	First control line
SYNC_OUT	Second control line
VCC	Power supply
GND	Ground

Claims

1. Interface (20) for communication between an internal device (10) and an external device (23), characterized by two bus lines (CANH, CANL) of a bus for bidirectional data transfer and by at least a first control line (SYNC_IN), by means of which a control signal can be transferred from the external device (23) to the internal device (10).

2. Interface according to Claim 1, characterized in that the bus lines (CANH, CANL) belong to a CAN bus.

3. Interface according to any of the preceding claims, characterized in that a second control line (SYNC_OUT) is provided, by means of which a control signal can be transferred from the internal device (10) to the external device (23).

4. Interface according to any of the preceding claims, characterized in that the control lines (SYNC_IN, SYNC_OUT) provided serve for unidirectional transfer.

5. Interface according to any of the preceding claims, characterized in that the internal device (10) picks up the control signal transferred by means of the first control line (SYNC_IN) into its data stream and stores it with the latter.

6. Interface according to any of the preceding claims, characterized in that the control signal on one of the control lines (SYNC_IN, SYNC_OUT) provided is assigned an identification sequence on the two bus lines (CANH, CANL), which identification sequence contains the information as to what event the control signal represents.

7. Interface according to Claim 6, characterized in that the identification sequence is temporally offset with respect to the control signal.

8. Interface according to Claim 6 or 7, characterized in that the internal device (10) picks up the identification sequence transferred by means of the bus lines (CANH, CANL) into its data stream and stores it with the latter.

9. Interface according to any of the preceding claims, characterized in that an operation mode that defines the temporal assignment between control signals and identification sequences is transferred by means of the bus lines (CANH, CANL).

10. Interface according to any of the preceding claims, characterized in that a power supply line (VCC) is provided.

11. Interface according to any of the preceding claims, characterized in that a ground (GND) is provided.

12. Interface according to any of the preceding claims, characterized in that a portable 3D-measuring instrument, in particular a laser scanner (10), is provided as the internal device, the interface (20) being assigned to the internal device (10).

13. Interface according to Claim 12, characterized in that the external device (23) with which the interface (20) communicates is assigned to a carriage (27) on which the portable 3D-measuring instrument provided as the internal device (10) is mounted.

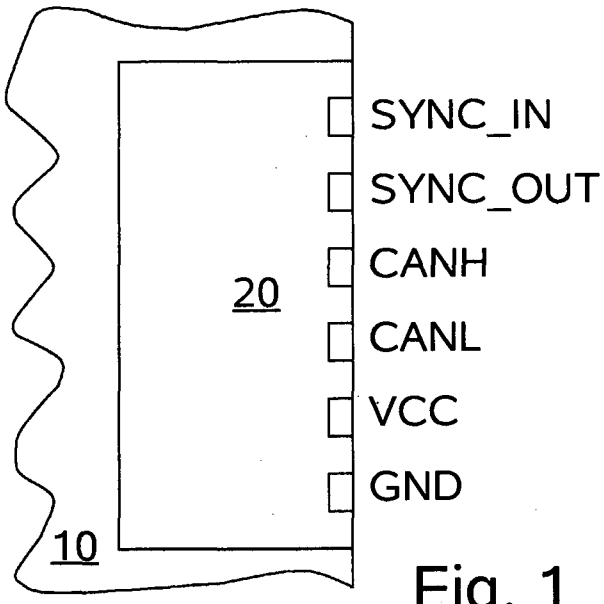

Fig. 1

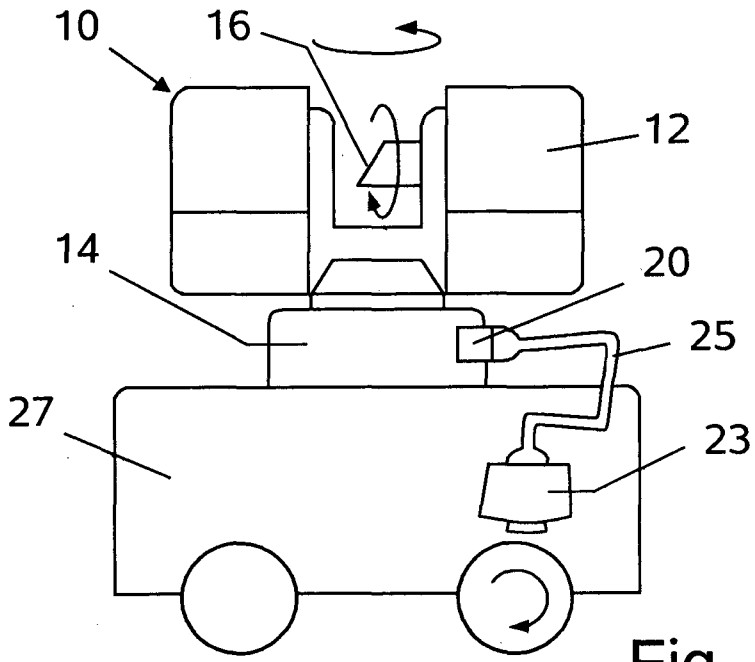

Fig. 2

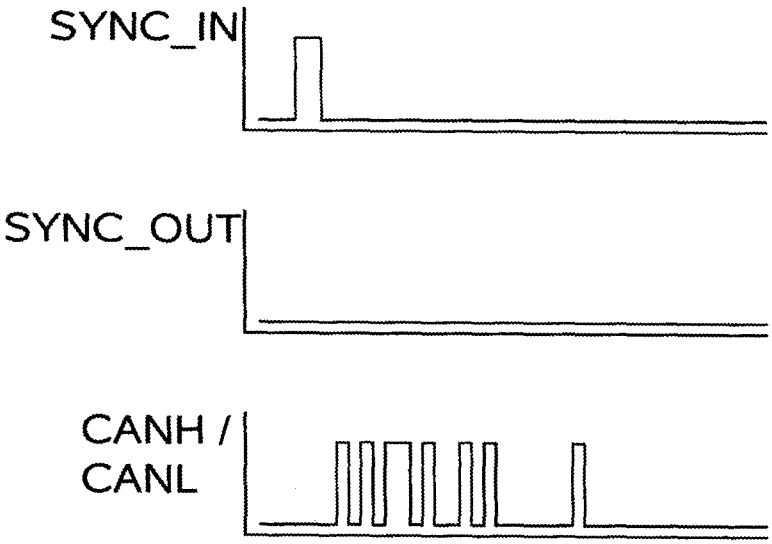

Fig. 3

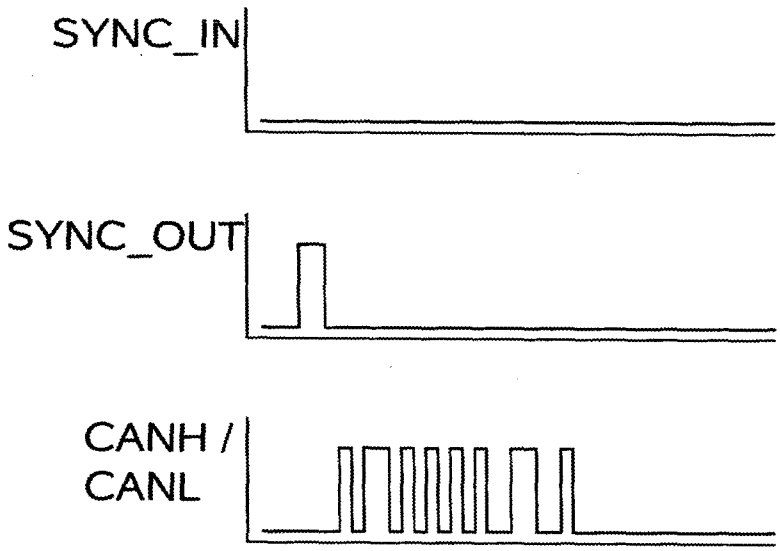

Fig. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2009/009174

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06F13/42
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, INSPEC, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	DE 10 2006 053611 A1 (FORD GLOBAL TECH LLC [US]) 24 May 2007 (2007-05-24) paragraph [0040] - paragraph [0047] figures 3,5,8	1-4, 10-13 5-9
X A	US 7 076 420 B1 (SNYDER WARREN [US] ET AL) 11 July 2006 (2006-07-11) paragraph [0040] - paragraph [0047]; figure 2 column 3, line 10 - column 4, line 12	1 2-13

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
30 April 2010	25/05/2010

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2009/009174

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102006053611 A1	24-05-2007	US 2007118269 A1	24-05-2007
US 7076420 B1	11-07-2006	NONE	