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(54) **Standard taximeter using GPS technology**

(57) The system permits verification of the functioning of a taximeter located in a taxi. The verification consists of checking that the tariffs calculated by the taximeter located in the taxi fall within the limits established by legislation, a problem that arises whenever the taximeter needs to be repaired and when a change takes place in the price of the tariffs (annually, following the appropriate official publication).

The system consists of a GPS receiver (1), an antenna (2), a microprocessor (3), an LCD panel (4), a keypad (5), a communications port (6) and a battery (7).

The GPS receiver (1) is in turn connected to: the antenna (2), the microprocessor (3), the LCD panel (4), the keypad (5) and the communications port (6).

The verification of the functioning of the taximeter is carried out by the system forming the object of this patent while the taxi is making a trip, processing the data line for position, speed and time which is picked up by the GPS receiver, with the taximeter of the taxi independently calculating the tariffs.

Control of the standard taximeter is by means of the keypad (5) and the display of the data is carried out in the LCD panel (4). By means of the communications port (6) the data in the system is transmitted to a personal computer. The battery (7) feeds the remaining devices of the system.

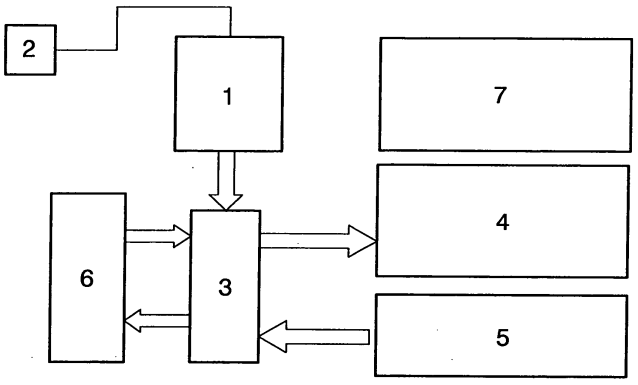

FIG. 1

EP 2 053 561 A2

Description

Field of the invention

[0001] The invention comes within the technical sector of automation, more specifically that relating to the technical inspection of vehicles and the checking of tachychronometric devices (taximeters).

Prior Art

[0002] The calculation of the price to charge for a taxi ride is determined by two factors: the time during which the taxi has not exceeded a certain speed (hauling speed) and the distance traveled when the speed is greater than the hauling speed. This price is calculated automatically by the tachychronometric devices or taximeters fitted to taxis.

[0003] Vehicles intended for taxi services must necessarily pass an annual vehicle technical inspection. This technical inspection checks the precision in the marking of taximeters (among other matters). In order to check the precision, the measurement provided by the taxi's taximeter is compared with the measurement provided by a certain system known as the standard taximeter. If the measurement read in the taximeter exceeds a maximum or fails to reach a minimum (both values being established in percentage terms in the existing legislation), then the taximeter is not valid and has to be repaired or replaced. If the measurement lies between the legal margins, the taximeter is sealed in the vehicle technical inspection centre.

[0004] The annual check on taximeters is usually carried out in January, since it is at the end of December of each year when the taxi tariffs are published for the following year; so, at the beginning of January, the owner of the taxi goes to a garage so that they can adapt the taximeter to the new tariffs and he then immediately tries to pass the appropriate technical inspection since by law he cannot provide a service until he has passed that inspection. In a city such as Madrid, there are about 13,000 taximeters that need to be "sealed" within the shortest possible time.

[0005] When, for any reason, the taximeter has to be repaired or replaced, it too has to be checked in a technical inspection.

[0006] The sources of error for calculating the price charged for a taxi service are:

1.- Errors in measuring the time taken between two given instants.
2.- Errors in measurement of the hauling speed.
3.- Errors in measurement of the distance traveled.

[0007] The apparatus that is currently used for checking tachychronometric devices or taximeters basically consists of two or more steel rollers between which the drive wheels of the vehicle are located. The rollers are provided with pulse generators (they generate a certain number of pulses per turn of the roller), therefore, knowing the diameter of those rollers and the pulses generated per unit of time (generally one second), it is possible to calculate the speed, determine whether it is greater or lesser than the hauling speed, and as appropriate calculate the distance traveled or the time taken.

[0008] The use of this apparatus presents certain deficiencies, as are:

a) The support (and therefore the deformation) of the tires on the cylindrical rollers is not equal to the support on a flat surface.
b) The rubber/steel friction is less than the rubber/asphalt friction.
c) The wheels of the vehicle stay aligned with its axis.

[0009] These deficiencies produce errors in measurement of the variables mentioned above, and these errors need to be estimated and delimited. Some of these errors can be estimated relatively easily (for example, the difference in the effective radius of the wheels depending on their size and the profile of the tire), while the upper limits for other errors are more complicated to estimate. For example, it is common for these standard taximeters to gather information on just one of the two front wheels of the vehicle, therefore the measurement of the distance traveled can be imprecise in a typical case in which the route does not have exactly the same number of equal turns (in radius and degrees) to the right and to the left; this situation is not considered in present-day systems.

[0010] There is currently a further problem in using this apparatus: electronic driving assistance systems (ABS, ESP, TCS, etc.) which are included in most vehicles nowadays. These systems detect anomalous situations and act as a consequence. One possible anomalous situation is that in which two wheels are turning and two wheels are not. In this case the safety systems come into action in order to correct the situation. The result of these actions is an overloading on the microprocessor (electronic switchboard) which can reach the point of causing it to fail.

[0011] In order to solve the problems mentioned above the system forming the object of this patent has been designed, a standard taximeter which permits the checking of taximeters in a real situation, namely, on a real route and at habitual speeds.

[0012] The development is based on the use of NAVSTAR-GPS technologies. The initials GPS identify a set of technologies which, by means of a device (GPS receiver) and an array of satellites in orbit above the earth, make it possible to estimate the position and speed of a mobile telephone on the earth's surface. The measurements that are collected in the GPS receiver are, among others, longitude, latitude, height, speed, number of satellites in use and time. Moreover, information is received on the time the signal takes to reach the receiver from each satellite.

[0013] The majority of GPS receivers can communicate with digital devices using the protocol NMEA0183. This protocol sends sentences such as the following: $GPRMC, 182023. 0123, A, 4321. 0564, N, 00549. 2310, W, 50. 21. 12, 120206, , , A*7[a]

[0014] Where data appears on longitude, latitude, speed, time and other values related to the number of satellites that are used for obtaining its geometry (relative location and with respect to the point of the earth's surface where the GPS receiver is located) and the precision of the measurement. It is then possible to program a digital device in order to perform certain calculations starting from the data present in the NMEA0183 sentences.

Object of the invention: technical problem adressed and solution proposed

[0015] For a proper check on the precision in the tariffs calculated by a taximeter, a device is needed that provides data in order to calculate the speed at which the taxi is traveling at each moment, the time during which the taxi travels at a speed below the hauling speed and the distance it travels at a speed greater than the hauling speed. This device has to have the characteristic of being portable, since the objective is to locate it in the taxi and conduct the check on the taximeter in a situation that is as close as possible to a real taxi ride.

[0016] To achieve this, the present invention makes use of GPS technology, which permits access to data on position, speed and time. This data will be processed in real time by a digital device programmed to calculate the pertinent tariffs. It is also possible to gather the necessary data for carrying out a trace of the check on the taximeter. This data can be downloaded into a personal computer for being stored.

Detailed description of the invention

[0017] The present invention makes reference to a novel device that permits taximeters to be checked. Unlike the devices that are currently used, the checking is carried out in a real situation (with the taxi following a real route) and using NAVSTAR-GPS technology (most current systems use a roller system).

[0018] The device is made up of a printed circuit board containing: a GPS receiver, an LCD panel or screen, a keypad, a microprocessor, a communications interface and a battery. There will also be a GPS antenna for improving the quality of the reception of the signal from the satellites, The interconnections of the different electronic devices are shown diagrammatically in figure 1.

[0019] The advantages presented by this system compared to traditional ones based on roller machines are:

a) The check of the taximeter is done on a real trip, in other words, in such a way that is as close as possible to the use of the taxi.

b) It is not necessary to make corrections due to the effect of the different deformations of the wheels of vehicles on the road and on rollers.

c) There is no need for an inspector from the company carrying out the check to be present during the test.

d) It is possible to check several taxis at the same time, one taxi for each of the standard taximeters which the company possesses.

e) Information is stored permitting the traceability of the check test.

f) The setting-up and maintenance costs are very much lower than those of roller machines.

[0020] The application of the invention is immediate, given the advantages it presents compared to other systems and the speed of setting-up and use in those companies that carry out checking services for taximeters, which are currently those that carry out vehicle technical inspections.

Description of the drawings

[0021] Figure 1 shows a diagram of the system to patent. The GPS receiver (1) is connected to the antenna (2). The processor (3) receives data from the receiver (1) in the form of an NMEA0183 sentence, on the basis of which it obtains data on position, speed and time, and data relating to the precision of the measurement. Depending on the speed, either the kilometer tariff or the hourly tariff is applied. If the speed is below the hauling speed, then the hourly tariff is taken into account, and if the speed is above the hauling speed, then the kilometer tariff is taken into account. At any particular instant, the tariff is composed of: the price for getting into the cab plus the part corresponding to the hourly tariff plus the part corresponding to the kilometer tariff.

[0022] Control of the standard taximeter (the object of this patent) is carried out by means of the keypad (5), from which the start of the test, the end of the test or the start of a new test can all be selected. When the end of test option is selected, the LCD panel or screen (4) is sent the calculated (real) tariff data and that of the maximum and minimum tariffs permitted according to legislation, along with data on the precision of the information gathered from the satellites.

[0023] All the gathered data can be stored in a personal computer by connecting the standard taximeter to the personal computer by means of the communications interface (6). The data on the price of getting into the cab, cost of a kilometer in the kilometer tariff and cost of the hour of waiting in the hourly tariff are transmitted to the system from a personal computer using this same communications interface. The whole system is electrically fed by the battery (7).

[0024] In figure 2 can be seen the external appearance that the system has when it has been placed in a box made of a resistant material (8) which permits access to the keypad (9), to the LCD screen (10), to the communi-

cations port (11), to the connector for charging the battery (12) and to the connector for the antenna (13).

Mode of embodiment

[0025] In one embodiment of the system to patent, the GPS receiver, the microprocessor, the battery and the communications interface, along with the printed circuit board where they are located, would be contained inside a box made of a resistant material. The box has to have the necessary openings for providing access to the keypad and to the LCD screen. It must in turn permit access to the connection plug of the antenna to the GPS receiver, to the communications interface and to a socket for charging the battery. The external appearance of such a box would be similar to that shown in Figure 2.

[0026] A prototype has been developed in which the FV-M5 GPS receiver and an antenna have been used, both from the company San José Navigation, along with an ATMEGA2561 microprocessor from the firm ATMEL, an MC 1604C-SYL LCD panel, a membrane keypad with 25 keys, an RS232C connections port and a lithium ion battery. The printed circuit board is own design, as is the software that is run in the microprocessor. The system is contained inside a plastic box having the characteristics described above.

Claims

1. Standard taximeter using GPS technology which, using the data obtained from the array of GPS satellites, calculates the speed of a vehicle and automatically selects the hourly or kilometer tariff to apply, calculating the cost of the taxi service and contributing data on the highest legal value and on the lowest legal value of that cost, along with the precision achieved as a function of the number and geometry of the satellites used; the device **characterized in that** comprises a GPS receiver (1), an antenna (2) connected to the GPS receiver, a microprocessor (3) which processes the data provided by the GPS receiver, an LCD screen or panel (4) for the display of information, a keypad (5) from where the functioning of the system is controlled, a communications port (6) for connection to a personal computer and a battery (7) which feeds the electronic devices of the system.

2. Standard taximeter using GPS technology, according to claim 1, **characterized in that** it permits the downloading of data to a personal computer by means of a communications port.

3. Standard taximeter using GPS technology, according to claim 1, **characterized in that** it permits the uploading of data on the tariffs from a personal computer using a communications port.

4. Standard taximeter using GPS technology, according to claims 1, 2 and 3, **characterized in that** it is contained in a box made of a resistant material which permits display of the LCD screen and access to the keypad, provided with openings which permit connection of the antenna, access to the communications port and to the battery charging system.

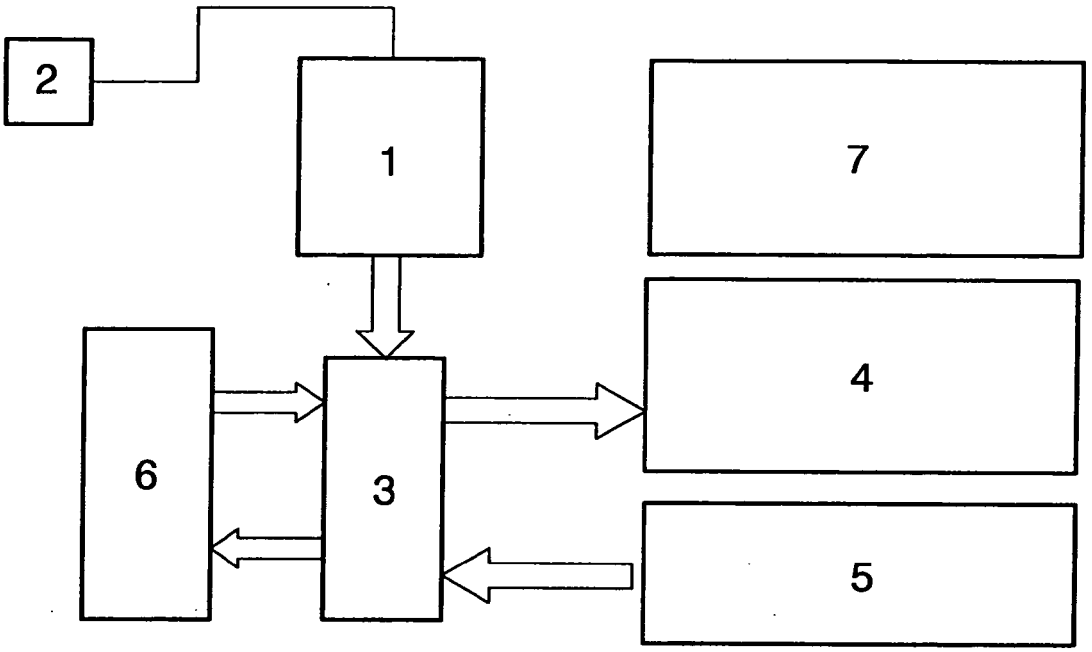

FIG. 1

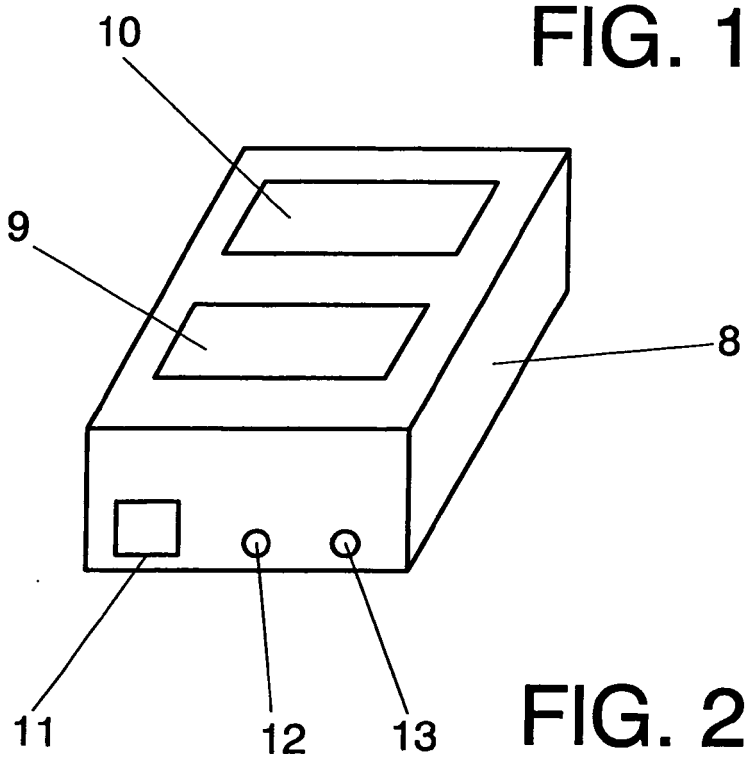

FIG. 2