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SECONDARY SENSING FOR INTELLIGENT PASSIVE ENTRY PASSIVE START POLLING

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] This invention relates generally to a system and method for polling a vehicle key FOB to determine when an authorized vehicle user is approaching a vehicle and, more particularly, to a system and method for polling a vehicle key FOB to determine when an authorized vehicle user is approaching a vehicle that includes using an infrared detector on the vehicle to identify a living thing in the vicinity of the vehicle and then using a low frequency (LF) pulsed signal to poll the key FOB if a living thing is identified so as to conserve battery power on the vehicle.

2. Discussion of the Related Art

[0002] Modern vehicles typically include a key FOB that wirelessly transmits RF command signals to a vehicle controller to perform certain vehicle functions, such as lock the doors, unlock the doors, open the trunk, open the hatch, start the engine, turn on a security light, etc. The vehicle operator will press a particular push button on the key FOB that typically has an image of the function that the button provides in order to transmit the command signal to the vehicle. The transmission is coded in such a manner that not only does the command perform a certain operation, but also protects the transmission from being recorded and resent by a third party. Key FOBs of this type typically have a limited range, and provide a convenience factor for the vehicle operator.

[0003] Modern vehicles also typically allow a vehicle driver to set various vehicle devices and systems, such as vehicle mirrors, seats, pedals, radio, etc., to a particular desirable setting, and then allow the driver to record those settings as pre-sets by activating a storing button. If the settings are changed from the last time the vehicle driver drove the vehicle, such as by another vehicle driver, then that vehicle driver can activate the pre-sets, such as by pressing the storing button or another button, so that all of the devices

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are returned to the desirable position for that driver. A signal transmitted from the key FOB identifying the vehicle driver can be used to set the various vehicle devices and system to the pres-set conditions, where the particular key fob is unique to the vehicle driver.

[0004] Systems have been proposed for a vehicle that cause a vehicle door handle to retract into the vehicle door for security purposes and upon detection of an authorized user will extend the handle to allow the driver to gain access to the vehicle. Current systems that deploy a vehicle handle from a retracted position may require about ten feet between when an authorized vehicle user is detected and when the user arrives at the vehicle to perform the operation satisfactorily.

[0005] As mentioned above, a typical system that allows a key FOB to provide vehicle commands is activated by the vehicle driver or other authorized user using the key FOB. It is desirable in some vehicle designs to cause the vehicle to perform the particular function automatically as the user approaches the vehicle, where the user is not required to actively transmit the signal. One known system, referred to as a passive entry passive start (PEPS) system, periodically interrogates or polls the area immediately around the vehicle to detect the key FOB using a low frequency (LF) pulsed signal (30 – 300 kHz) transmitted from the vehicle at a predetermined pulse rate. The pulse width and the pulse rate of the polling signal is set based on how fast the user could be approaching the vehicle and how far from the vehicle it is desirable to first detect the user. When the key FOB receives the low frequency pulsed polling signal, and authenticates it, the key FOB will automatically transmit a command signal to the vehicle so that the vehicle will perform the particular function that is has been programmed to perform.

[0006] Low frequency signals are typically used for the key FOB polling because they only radiate a short distance. Further, because of the short range of the low frequency pulsed polling signal, it is possible to interrogate directionally, such as at the left or right side of the vehicle or the front or rear of the vehicle. Thus, because the vehicle can know the direction of the approaching user, the vehicle need only open the door for that side.

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[0007] Generating and transmitting low frequency signals typically requires a large amount of current, typically on the order of about 700 mA, for each pulse that is transmitted. Therefore, the amount of time that the vehicle is able to provide the pulsed polling signal at the low frequency before the vehicle battery voltage is reduced to an unacceptable state-of-charge, below which the driver may not be able to start the vehicle, is relatively short, for example, on the order of 12-24 hours. When this time has passed since the last time the vehicle was started, the PEPS system will go into a sleep mode, and not be able to provide the polling signal.

SUMMARY OF THE INVENTION

[0008] In accordance with the teachings of the present invention, a system and method are disclosed for providing a polling signal transmitted from a vehicle that is received by a key FOB held by an authorized user of the vehicle as the user approaches the vehicle. When the key FOB receives the polling signal, it will automatically transmit a command signal back to the vehicle for some vehicle operation to be performed. Battery power is conserved on the vehicle by using an infrared detector to first detect whether a living thing is in proximity of the vehicle prior to the vehicle transmitting the polling signal.

[0009] Additional features of the present invention will become apparent from the following description and appended claims, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Figure 1 is an illustration of a vehicle and a key FOB in proximity to the vehicle;

[0011] Figure 2 is flow chart diagram showing an operation for detecting an object near the vehicle, and if so, initiating a PEPS polling signal;

[0012] Figure 3 is an illustration of a vehicle and a key FOB in proximity to the vehicle where the vehicle uses the VHF-UHF band to poll the key FOB;

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[0013] Figure 4 is a graph with time on the horizontal axis and magnitude on the vertical axis showing a pulsed polling signal for the UHF-VHF signal;

[0014] Figure 5 is an illustration of a vehicle with two polling transceivers;

[0015] Figure 6 is an illustration of the vehicle shown in figure 6 with three polling transceivers;

[0016] Figure 7 is a flow chart diagram showing a process for determining whether the key FOB is in motion;

[0017] Figure 8 is a flow chart diagram showing a process for determining whether the key FOB recently received an authorized response from the vehicle; and

[0018] Figure 9 is a flow chart diagram showing a process for determining whether the vehicle is on or off.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0019] The following discussion of the embodiments of the invention directed to a system and method for determining if a living thing is near a vehicle prior to initiating a polling signal is merely exemplary in nature, and is in no way intended to limit the invention or its applications or uses.

[0020] Figure 1 is an illustration of a vehicle system 10 including a vehicle 12 and a key FOB 14 in close proximity thereto, which would be carried by a driver or authorized user of the vehicle 12. The key FOB 14 includes a plurality of buttons 18 that can be pressed by the vehicle user when the user is within a certain distance of the vehicle 12 to transmit a key FOB command signal 16 that causes the vehicle 12 to perform some operation, such as lock the vehicle doors, unlock the vehicle doors, open the vehicle hatch, start the vehicle, etc., in a manner that is well understood by those skilled in the art. In addition to these operations, the vehicle 12 can also include security lights 28 and 30 that can be turned on in response to receiving the command signal 16, and retractable door handles 32 in the

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doors of the vehicle 12 that can be extended when the vehicle 12 receives the command signal 16.

[0021] As discussed above, systems are known in the art that automatically perform these operations where the vehicle 12 may include a PEPS module 22 on the vehicle 12 that generates a LF pulsed polling signal 20 that is received by the key FOB 14, and which causes the key FOB 14 to automatically transmit the signal 16 to the vehicle 12 to perform one or more of the operations referred to above without actual intervention by the vehicle user. The pulsed polling signal 20 will have a predetermined pulse width and pulse rate that can be determined based on how fast the authorized user may be approaching the vehicle 12 and/or at what distance the user is detected from the vehicle 12, consistent with the discussion herein. The vehicle 12 includes various modules that perform various operations on the vehicle 12 in response to receiving the key FOB command signal 16, such as a body control module (BCM) 24 and an ESCL module 26, all well known to those skilled in the art.

[0022] The vehicle system 10 can be designed in any manner suitable for a particular type of vehicle or a particular type of vehicle design where the buttons 18 may or may not be part of the key FOB 14 so that all of the vehicle operations can be automatically performed upon receiving the polling signal 20, or some of the desired vehicle functions can be performed automatically and some can be performed by the operation of the buttons 18 on the key FOB 14.

[0023] According to the invention, the vehicle 12 includes an infrared (IR) detector 34 that detects heat from living things within a certain range of the vehicle 12 that may be warmer than the environment. Heat signature signals emitted by a living object will be received by the detector 34 to indicate that a living thing is present. Suitable examples of such detectors include the commercially available Siemens IR detection system and the STE electronics application infrared detection system. The particular infrared detector being employed can be selected and calibrated for detecting living things within a pre-defined range from the vehicle 12, a particular size of an

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