A method for announcing the replacement time of an air filter in an HVAC system of a vehicle includes the steps of inputting factors used for judging whether the air filter should be replaced; determining whether inside air or outside air is supplied; calculating a total amount of dust by calculating a dust concentration reduction per unit volume by considering a total amount of introduced air and an initial inside dust concentration if inside air is supplied, or calculating a total amount of dust using an amounts of air at a current operation level if outside air is supplied; determining whether the total amount of dust exceeds a reference amount of dust; and activating an indicator, such as an alarm or a warning light, if the total amount of dust exceeds the reference amount of dust.
FIG. 2

Start

input factors

outside air?
  Yes
  S20
  blower voltage = 0?
    Yes
    S40
    apply preset amount of air
    S50
    calculate total amount of dust
    S60
  No
    No

  calculate amount of air
  S30

  Yes
  S70
  calculated amount of dust > reference amount of dust
  No
  S90
  store amount of dust on air filter

output alarm sound or displaying alarm

End
METHOD OF ANNOUNCING REPLACEMENT TIME OF AIR FILTER IN A HEATING, VENTILATING, AND AIR-CONDITIONING SYSTEM OF A VEHICLE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application is based on, and claims priority from, Korean Application Serial Number 10-2005-0122040, filed on Dec. 12, 2005, the disclosure of which is hereby incorporated by reference herein in its entirety.

FIELD OF THE INVENTION

[0002] The present invention relates to a method of announcing the replacement time of an air filter in a heating, ventilating and air-conditioning (HVAC) system of a vehicle, and more particularly, to a method of announcing the replacement time of an air filter in an HVAC system of a vehicle that automatically announces the exact replacement time depending upon the operating status of the HVAC system, including the operating conditions, the characteristics of the air filter, and regional features.

BACKGROUND OF THE INVENTION

[0003] As is generally known in the art, an HVAC system of a vehicle is used as an automatic air conditioner, in which a heater and a cooler are modularized in order to maintain the temperature in a passenger compartment at a level desired by the driver.

[0004] There are three conventional techniques for announcing the replacement time of the air filter. In the first technique, pressure loss through the inlet and outlet of the air filter is measured. In the second technique, the degree of contamination of the air filter is directly measured, for example with using an infrared sensor. In the third technique, the degree of contamination of the air filter is indirectly measured using an air flow speed sensor.

[0005] However, in each of the above three techniques, since a separate sensor is used to measure the amount of air, the air pressure, or the degree of contamination of the air filter, the cost and weight of the vehicle increase, and it is difficult to install the HVAC system in the vehicle.

[0006] The above information disclosed in this Background section is only for enhancement of understanding of the background of the invention and therefore it may contain information that does not form the prior art that is already known in this country to a person of ordinary skill in the art.

SUMMARY OF THE INVENTION

[0007] The present invention provides a method for announcing the replacement time of an air filter in an HVAC system of a vehicle which can automatically announce the exact replacement time of an air filter depending upon the operating conditions of an HVAC system of a vehicle, the characteristics of the air filter, and regional features.

[0008] A method for announcing the replacement time of an air filter in an HVAC system of a vehicle according to an embodiment of the present invention, comprises the steps of inputting factors used for judging whether the air filter should be replaced; determining whether inside air or outside air is supplied; calculating the total amount of dust by calculating the dust concentration reduction per unit volume using the total amount of introduced air and an initial inside dust concentration when it is determined that inside air is supplied, or calculating the total amount of dust using the amounts of air at respective operation levels and an air direction in accordance with the operation of a blower motor when it is determined that outside air is supplied; determining whether the calculated total amount of dust exceeds a reference amount of dust which is preset for the air filter; and activating an indicator, such as an alarm or a warning light, when the total amount of dust on the air filter exceeds the reference amount of dust.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] For a better understanding of the nature and objects of the present invention, reference should be made to the following detailed description with the accompanying drawings, in which:

[0010] FIGS. 1a and 1b are a front view and an exploded perspective view illustrating the construction of an HVAC system according to exemplary embodiments of the present invention; and

[0011] FIG. 2 is a flow chart illustrating a method for announcing the replacement time of an air filter in a heating, ventilating and air-conditioning system of a vehicle in accordance with an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0012] Reference will now be made in greater detail to embodiments of the invention, an example of which is illustrated in the accompanying drawings. Wherever possible, the same reference numerals will be used throughout the drawings and the description to refer to the same or like parts.

[0013] Referring to FIG. 1a, an HVAC system 100 includes an air inlet section 20, a blower unit 30, and a heating and cooling unit 10. Referring to FIG. 1b, the heating and cooling unit 10 includes an air supply position adjustment section 2a, 2b and 2c, the air temperature control section 4, and the air flow direction adjustment section 6; as well as the position of the air inlet section 20, and the operating level of the motor of the blower unit 30.

[0014] Referring to FIG. 2, in order to automatically announce the replacement time of an air filter in a heating, ventilating and air-conditioning system of a vehicle, factors used for judging whether the air filter must be replaced are input (S10).

[0015] The input factors may include regional pollution levels. The values of variables are input in advance on the basis of the average dust pollution levels of various regions so that the air filter replacement period is short in heavily polluted regions and longer in relatively unpolled regions.
In this way, diverse regional features can be considered when determining the replacement time of the air filter.

[0016] The input factors may further include the type of air filter; the air filter replacement period is short for an air filter having a fine mesh structure and longer for an air filter having a coarse mesh structure.

[0017] The input factors may further include passenger compartment size. The total amount of dust in the passenger compartment under an inside air circulation mode varies with the volume of the passenger compartment. Thus, the difference in the amount of dust must be compensated for depending upon the kind of car.

[0018] After the factors are input at step S10, whether inside air or outside air is being supplied is determined (S20). As a result of the determination in step S20, if it is determined that inside air is being supplied, a heater controller calculates the amount of air, and the total amount of dust is calculated by calculating the dust concentration reduction per unit volume using the initial inside dust concentration (S30, S60). On the other hand, as a result of the determination in step S20, if it is determined that outside air is being supplied, and if a blower is not driven, a preset amount of air (e.g., 60 m³/h), which indicates the average amount of air introduced into the car by air pressure under an outside air inflow mode) is used. If the blower is driven, after the heater controller calculates the amount of air, an amount of dust V=QH is calculated (S60), where V is the total amount of introduced air, Q is the amount of air introduced per unit time, and H is elapsed time.

[0019] The total amount of dust W=VC on the air filter is then calculated, where W is the total weight of dust, V is the total amount of introduced air as calculated above, and C is the concentration of dust.

[0020] After the total amount of dust is calculated in step S60, whether the calculated total amount of dust exceeds a reference amount of dust which is preset for the air filter is determined (S70). If the calculated total amount of dust exceeds the reference amount of dust, an indicator, such as an alarm or a warning light, is activated to announce the replacement time of the air filter (S80). If the calculated total amount of dust does not exceed the reference amount of dust, the calculated amount of dust on the air filter is stored (S90).

[0021] In some embodiments, different pollution levels can be assigned to different regions. For example, due to the various running conditions for cars in Seoul, China and the U.S.A. which have different air pollution levels, the amounts of dust which accumulate on air filters vary. Therefore, in a state in which the values of variables are input in advance based on the average dust pollution levels of various regions (as compiled by an international environmental association), the air filter replacement period is short in heavily polluted regions and longer in less polluted regions.

[0022] As is apparent from the foregoing, the present invention provides advantages in that, since the exact replacement time of an air filter can be automatically announced to a consumer, it is possible to prevent offensive odors from being generated to be introduced into the passenger compartment of the vehicle and prevent a performance of an air conditioner or heater from being reduced due to the contamination of the air filter.

[0023] Although preferred embodiments of the present invention have been described for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

What is claimed is:

1. A method of announcing the replacement time of an air filter in a heating, ventilating, and air conditioning system of a vehicle, comprising the steps of:

   inputting factors used for judging whether the air filter must be replaced;

   determining whether inside air or outside air is supplied;

   calculating a total amount of dust, the calculating a total amount of dust comprising:

   if inside air is supplied, calculating a dust concentration reduction per unit volume by considering a total amount of introduced air and an initial inside dust concentration; and

   if outside air is supplied, calculating the total amount of dust using an amount of air at a current operation level and an air direction;

   determining whether the total amount of dust exceeds a reference amount of dust; and

   activating an indicator if the total amount of dust exceeds the reference amount of dust.

2. The method as defined in claim 1, wherein the factors comprise a regional pollution level, an air filter type, and a passenger compartment volume of the vehicle.

3. The method as set forth in claim 1, wherein the step of calculating the total amount of dust further comprises using a preset amount of air if a blower motor is not driven and outside air is supplied.

4. The method as set forth in claim 3, wherein the preset amount of air is approximately 60 cubic meters per hour.

5. The method as set forth in claim 1, wherein the total amount of introduced air V is calculated from V=QH, where Q is an amount of air introduced per unit time, and H is time.

6. The method as set forth in claim 1, wherein the total amount of dust W on the air filter is calculated from W=VC, where V is a total amount of introduced air, and C is a concentration of dust.

7. The method as set forth in claim 1, further comprising the step of:

   storing the total amount of dust on the air filter if the total amount of dust on the air filter does not exceed the reference amount of dust.

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