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(54) **PASSENGER DETECTION DEVICE OF AUTOMOBILE**

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(57) **ABSTRACT**

A passenger detection device of an automobile that can easily detect a passenger's weight is provided. The passenger detection device of an automobile includes: a weight sensor module for detecting a first voltage difference value and a first temperature at a first point of a seat; and a smart sensor module for detecting a second voltage difference value and a second temperature at a second point of the seat, calculating a final weight of the first and second voltage difference values using the first and second temperatures, and detecting a passenger by comparing the final weight and a setting reference.

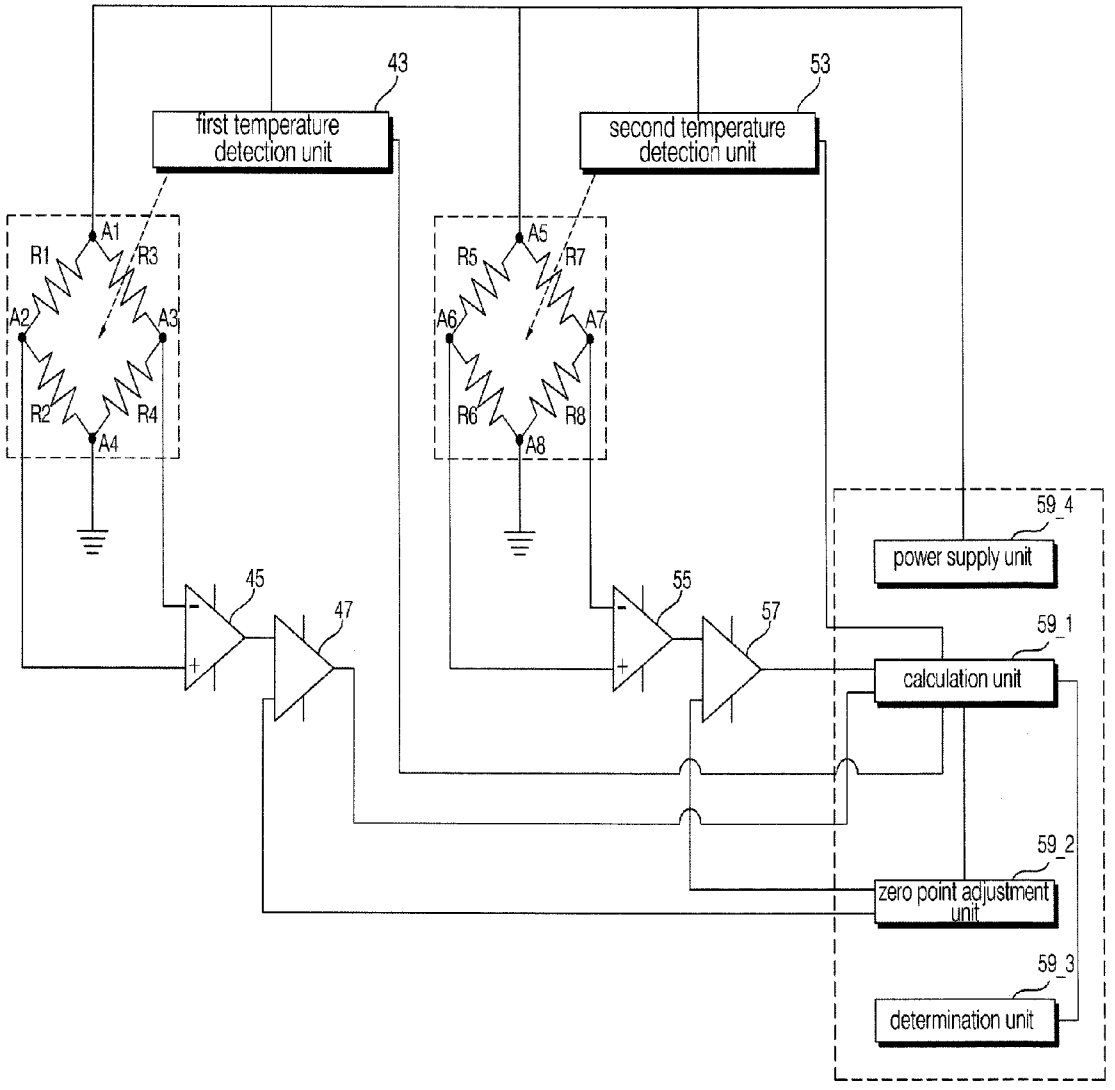


FIG. 1

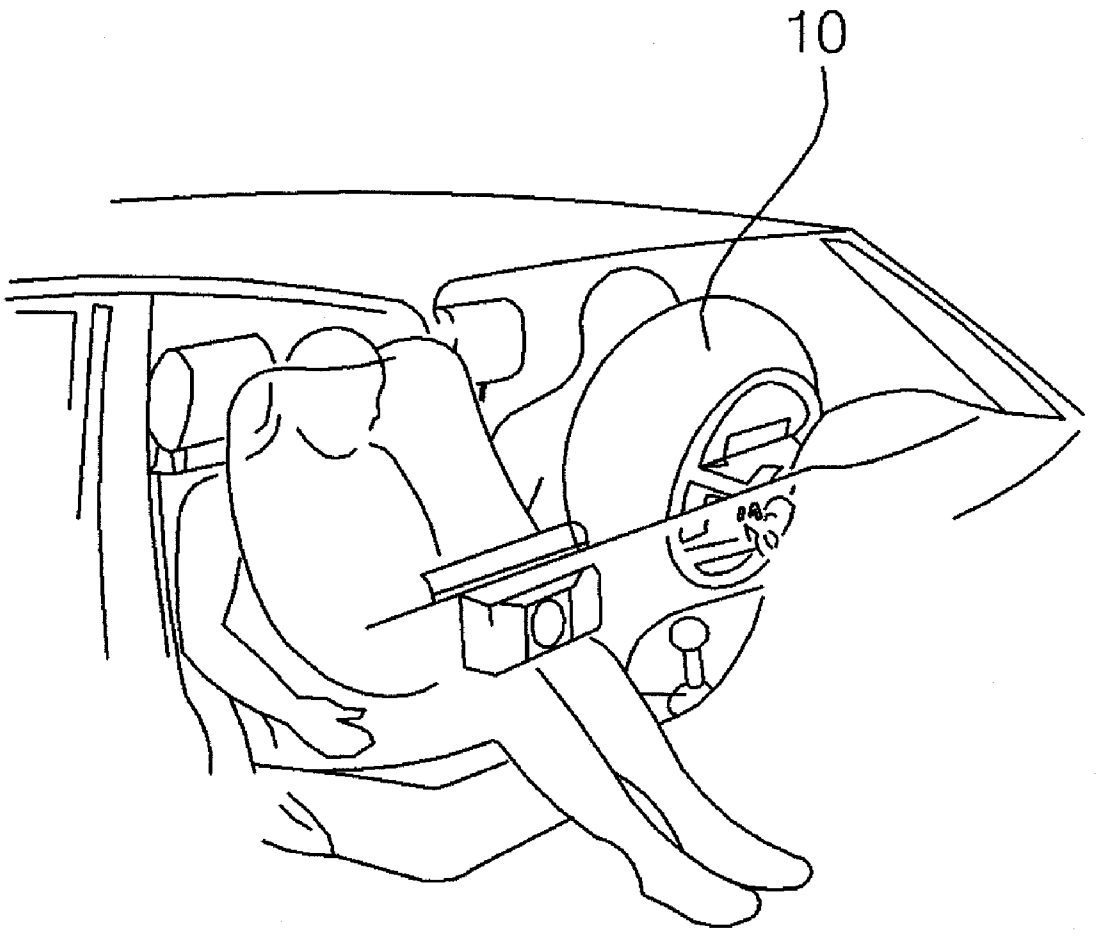


FIG. 2

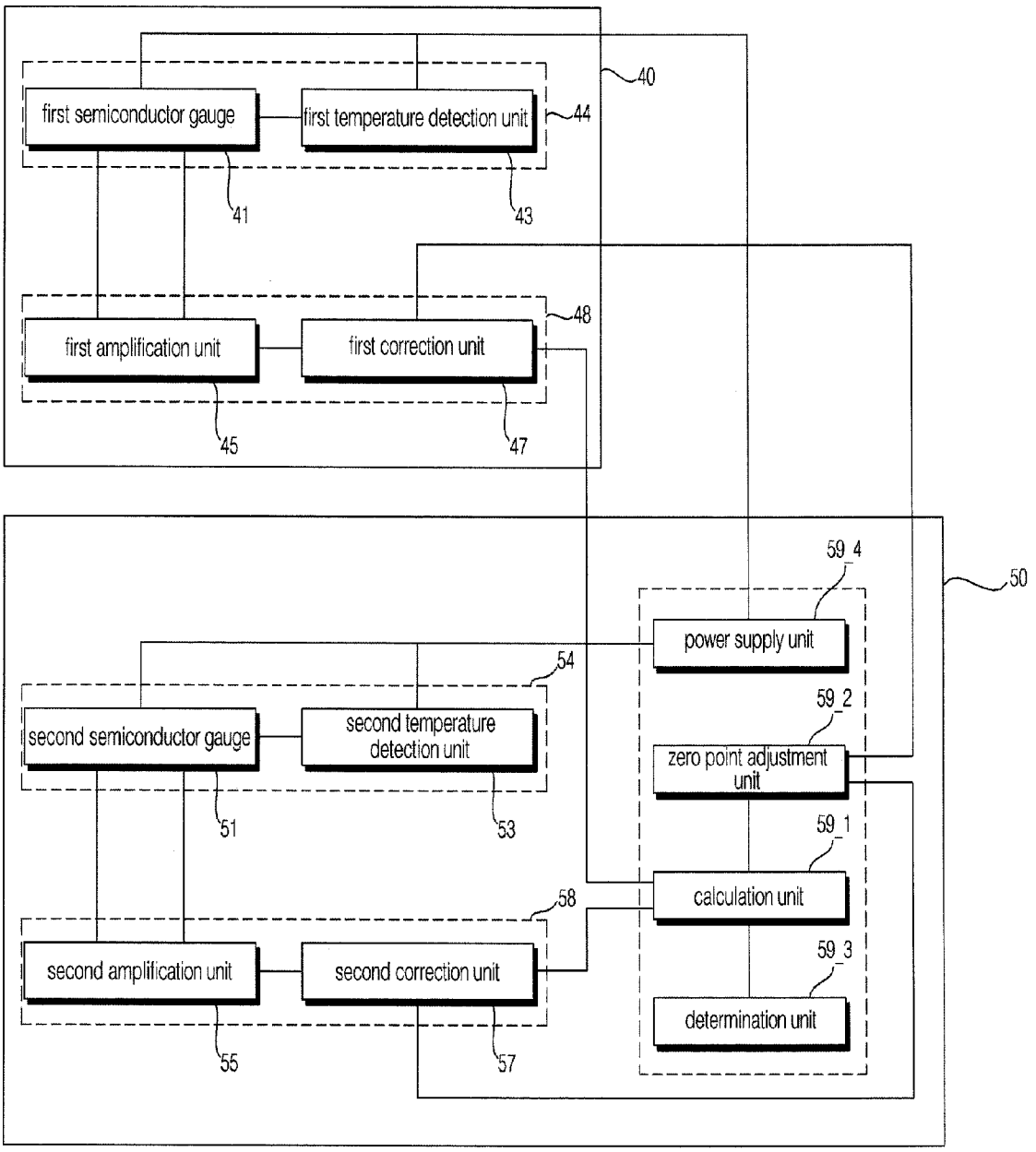
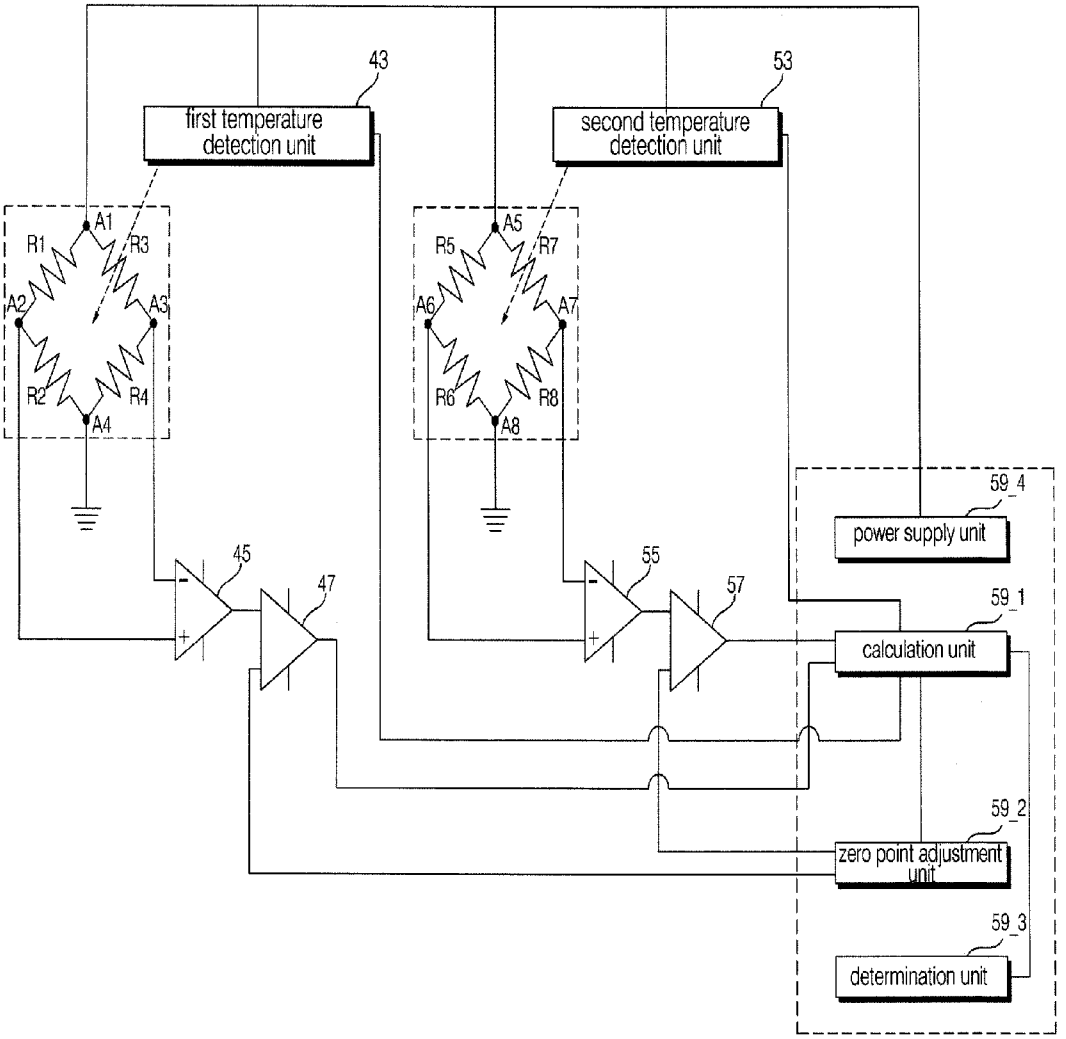

40
first semiconductor gauge
first temperature detection unit
44
41
43
48
first amplification unit
first correction unit
45
47
50
59_4
power supply unit
54
second semiconductor gauge
second temperature detection unit
59_2
zero point adjustment unit
51
53
59_1
calculation unit
58
second amplification unit
second correction unit
59_3
determination unit
55
57

FIG. 3


43
first temperature detection unit
53
second temperature detection unit
A1
R1
R3
A2
A3
R2
R4
A4
A5
R5
R7
A6
A7
R6
R8
A8
45
47
55
57
59_4
power supply unit
59_1
calculation unit
59_2
zero point adjustment unit
59_3
determination unit

PASSENGER DETECTION DEVICE OF AUTOMOBILE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of Korean Application No. 2008-0065011, filed on Jul. 4, 2008 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a passenger detection device of an automobile that can easily detect a passenger's weight.

[0004] 2. Description of the Related Art

[0005] In general, an automobile is completed by assembling and mounting about 3,000 parts consisting of design parts and electrical parts of the inside and the outside of an automobile room such as an interior component, a dashboard, a seat, window glass, and an electrical component, and units such as an engine, a transmission, and an axle in an automobile body and performing wiring and piping operations and is launched as a product after a quality check.

[0006] Further, in order to improve performance of the automobile, the automobile depends on the control of an advanced electronic device in many portions.

[0007] Particularly, by improving performance of an engine using various sensors, optimum engine efficiency is obtained and thus reliability of the automobile is improved.

[0008] Further, for driver convenience, safety of a driver and a passenger as well as actual engine driving, by detecting the passenger's weight and classifying an adult and a child using an advanced electronic device, the passenger's safety can be improved.

[0009] Therefore, nowadays, in order to secure safety of the passenger and the driver, an apparatus for detecting the passenger's weight has been developed.

SUMMARY OF THE INVENTION

[0010] The present invention has been made in an effort to solve the above problems, and the present invention provides a passenger detection device of an automobile that can easily detect a passenger's weight.

[0011] According to an aspect of the present invention, there is provided a passenger detection device of an automobile including: a weight sensor module for detecting a first voltage difference value and a first temperature at a first point of a seat; and a smart sensor module for detecting a second voltage difference value and a second temperature at a second point of the seat, calculating a final weight according to preset temperature correction values corresponding to the first and second temperatures and the first and second voltage difference values, and detecting a passenger by comparing the final weight and a setting reference.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The present invention will become more fully understood from the detailed description given herein below and the accompanying drawings, which are given by illustration only, and thus are not limitative of the present invention, and wherein:

[0013] FIG. **1** is a view schematically illustrating an inflation state of an air bag of an automobile according to an exemplary embodiment of the present invention;

[0014] FIG. **2** is a block diagram illustrating a configuration of a passenger detection device of an automobile according to an exemplary embodiment of the present invention; and

[0015] FIG. **3** is a circuit diagram of the passenger detection device of FIG. **2**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0016] Hereinafter, exemplary embodiments of a passenger detection device of an automobile according to the present invention will be described in detail with reference to the accompanying drawings.

[0017] FIG. **1** is a view schematically illustrating an inflation state of an air bag of an automobile according to an exemplary embodiment of the present invention.

[0018] When a collision accident occurs in an automobile, in order to safely protect a passenger using a cushion operation, an air bag **10** is installed at the front or the side of the automobile.

[0019] Referring to FIG. **1**, the air bag **10** is classified into an air bag (DAB) for a driver's seat installed at a steering wheel in order to protect the front of a driver seated in the driver's seat and an air bag (PAB) for a passenger' seat installed at an instrument panel in order to protect the front of a passenger seated in the passenger' seat.

[0020] Further, nowadays, in order to protect a passenger from a side collision as well as a front collision, a side air bag installed within the back of a seat, or a door trim of the automobile, a curtain air bag mounted in a roof rail and to be inflated in a curtain form between the passenger and a side window, and a side protection air bag of an inflatable tubular structure (ITS) mounted within a head liner of the upside of a front seat door are mounted in the automobile.

[0021] Because the air bag **10** instantaneously inflates by inflation gas of a high pressure, excessive inflation of the air bag **10** may injure a passenger. By inflating the air bag **10** with an appropriate inflation pressure according to a passenger type based on a body condition, in order to protect the passengers of various body conditions, the air bag **10** is controlled by a passenger detection device (not shown) including a weight sensor and a smart sensor for detecting a passenger's weight.

[0022] FIG. **2** is a block diagram illustrating a configuration of a passenger detection device of an automobile according to an exemplary embodiment of the present invention.

[0023] Referring to FIG. **2**, a passenger detection device according to the present exemplary embodiment includes a weight sensor module **40** and a smart sensor module **50**.

[0024] The weight sensor module **40** and the smart sensor module **50** are positioned at first and second points, respectively of a lower part of a seat (not shown). For example, the weight sensor module **40** may be positioned at the center of the left side of the lower part of the seat, and the smart sensor module **50** may be positioned at the center of the right side of the lower part of the seat.

[0025] The weight sensor module **40** detects a first voltage difference value and a first temperature at the first point at which the passenger is seated and transfers the first voltage difference value and the first temperature to the smart sensor module **50**.

[0026] The weight sensor module **40** includes a first sensing unit **44** for detecting first and second voltage values and the first temperature at the first point and a first level amplification unit **48** for outputting a first voltage difference value, which is a difference value between the first and second voltage values and correcting a zero point of the first voltage difference value.

[0027] Further, the weight sensor module **40** provides the first voltage difference value to the smart sensor module **50**. Therefore, the smart sensor module **50** calculates a first weight value with reference to the first voltage difference value and a preset weight calculation value, temperature correction value, and resistance error correction value. The weight calculation value is a value for calculating a voltage difference value to a weight value, the temperature correction value is a value for correcting a semiconductor gauge output value that is different according to a temperature, and the resistance error correction value is a value for correcting an error of a resistance value included in the semiconductor gauge. The smart sensor module **50** acquires a second voltage difference value, calculates a second weight value with reference to the second voltage difference value and the preset weight calculation value, temperature correction value, and resistance error correction value, and calculates a final weight by adding the first weight value and the second weight value.

[0028] The first sensing unit **44** includes a first semiconductor gauge **41** for detecting the first and second voltage values and a first temperature detection unit **43** for detecting the first temperature at the inside or the outside of the first semiconductor gauge **41**.

[0029] In the first semiconductor gauge **41**, a plurality of semiconductor resistors (not shown) having varying resistance values are connected in a bridge form.

[0030] The first semiconductor gauge **41** outputs the first and second voltage values at the first point.

[0031] Further, the first temperature detection unit **43** detects a temperature of the first semiconductor gauge **41** at any time and outputs the first temperature. That is, as the first semiconductor gauge **41** sensitively reacts to a heat, the first and second voltage values are affected by a temperature, and thus the first temperature detection unit **43** detects the first temperature in order to compensate a temperature.

[0032] The first level amplification unit **48** includes a first amplification unit **45** for amplifying and outputting a first voltage difference value, which is a difference value between the first and second voltage values and a first correction unit **47** for correcting and outputting a zero point of the first voltage difference value.

[0033] The first amplification unit **45** is preferably an operating amplifier (op-amp) and outputs the first voltage difference value in which the first and second voltage values are supplied and amplified to an inversion terminal and a non-inversion terminal, respectively.

[0034] The first correction unit **47** corrects a zero point of the first voltage difference value using the first voltage difference value and a first zero point signal supplied from the smart sensor module **50**. In this case, when a voltage value calculated between two of a plurality of semiconductor resistors included in the semiconductor gauge is different from a reference voltage value, zero point correction is performed in order to correct the voltage value.

[0035] The smart sensor module **50** includes a second sensing unit **54** for detecting third and fourth voltage values and the second temperature at the second point, a second level amplification unit **58** for acquiring a second voltage difference value, which is a difference value between the third and four voltage values and correcting a zero point of the second voltage difference value, and a controller **59** for calculating a final weight according to the first and second voltage difference values, detecting a passenger by comparing the final weight and a setting reference, and controlling the first and second level amplification units **48** and **58** in order to correct a zero point of the first and second voltage difference values.

[0036] That is, the smart sensor module **50** acquires a second voltage difference value, calculates a second weight value with reference to the second voltage difference value and the preset weight calculation value, temperature correction value, and resistance error correction value, and calculates a final weight by adding the second weight value and the first weight value calculated by the first voltage difference value received from the weight sensor module **40**.

[0037] The second sensing unit **54** includes a second semiconductor gauge **51** for detecting the third and fourth voltage values and a second temperature detection unit **53** for detecting the second temperature at the inside or the outside of the second semiconductor gauge **51**.

[0038] In the second semiconductor gauge **51**, a plurality of semiconductor resistors (not shown) having varying resistance values are connected in a bridge form.

[0039] The second semiconductor gauge **51** outputs the third and fourth voltage values at the second point.

[0040] Further, the second temperature detection unit **53** detects a temperature of the second semiconductor gauge **51** at any time and outputs the second temperature. That is, as the second semiconductor gauge **51** sensitively reacts to a heat, the third and fourth voltage values are affected by a temperature, and thus the second temperature detection unit **53** detects the second temperature in order to compensate a temperature.

[0041] The second level amplification unit **58** includes a second amplification unit **55** for amplifying and outputting a second voltage difference value, which is a difference value between the third and fourth voltage values and a second correction unit **57** for correcting and outputting a zero point of the second voltage difference value.

[0042] The second amplification unit **55** is preferably an operating amplifier (op-amp) and outputs the second voltage difference value in which the third and fourth voltage values are supplied and amplified to an inversion terminal and a non-inversion terminal, respectively.

[0043] The second correction unit **57** corrects a zero point of the second voltage difference value using the second voltage difference value and a second zero point signal supplied from the controller **59**.

[0044] The controller **59** includes a calculation unit **59_1** for calculating the final weight according to a preset temperature correction value corresponding to the first and second temperature, a zero point adjustment unit **59_2** for supplying the first and second zero point signals to the first and second level amplification units **48** and **58**, and a determination unit **59_3** for determining whether the passenger is detected by comparing the final weight with the setting reference, and a power supply unit **59_4** for supplying power to the first and second sensing units **44** and **54**.

[0045] The calculation unit **59_1** has a lookup table in which a correction value for a temperature change amount based on a reference temperature, compensates the first and second temperatures through the lookup table, and thus calculates a final weight.

[0046] The zero point adjustment unit **59_2** outputs the first and second zero point signals to the first and second correction units **47** and **57** in order to correct zero points of the first and second voltage difference values.

[0047] The determination unit **59_3** determines, if the final weight satisfies the setting reference, that the passenger is detected and determines, if the final weight does not satisfy the setting reference, that the passenger is not detected.

[0048] If the passenger is detected, the determination unit **59_3** determines whether the passenger is an adult or an infant based on the setting reference and transfers information about the passenger to a control unit for adjusting an air pressure of an air bag when the air bag is inflated according to the determination.

[0049] That is, when the final weight satisfies a passenger detection minimum value with reference to a determination reference database, the determination unit **59_3** determines that the passenger is detected and in this case, if the final weight is a preset adult threshold value or more referring again to the determination reference database, the determination unit **59_3** determines that the passenger is an adult, and if the final weight is less than a preset adult threshold value referring again to the determination reference database, the determination unit **59_3** determines that the passenger is an infant.

[0050] FIG. **3** is a circuit diagram of the passenger detection device of FIG. **2**.

[0051] Referring to FIG. **3**, a passenger detection device according to the present exemplary embodiment includes a weight sensor unit **40** and a smart sensor module **50**.

[0052] The weight sensor module **40** includes a first sensing unit **44** and a first level amplification unit **48**.

[0053] The first sensing unit **44** includes a first semiconductor gauge **41** in which first, second, third, and fourth semiconductor resistors R**1**, R**2**, R**3**, and R**4** having varying resistance values are connected in a bridge form and a first temperature detection unit **43** for detecting a first temperature at the inside and the outside of the first semiconductor gauge **41**.

[0054] In the first semiconductor gauge **41**, power of the power supply unit **59_4** included in the smart sensor module **50** is supplied to a first contact point A**1** at which the first and third semiconductor resistors R**1** and R**3** are connected, a first voltage value is output to a second contact point A**2** at which the first and second semiconductor resistors R**1** and R**2** are connected, and a second voltage value is output to a third contact point A**3** at which the third and fourth semiconductor resistors R**3** and R**4** are connected, and a fourth contact point A**4** at which the second and fourth semiconductor resistors R**2** and R**4** are connected is connected to the ground.

[0055] The first voltage value is a voltage output at the second contact point A**2**, i.e. between the first and second semiconductor resistors R**1** and R**2**, and the second voltage value is a voltage output at the third contact point A**3**, i.e. between the third and fourth semiconductor resistors R**3** and R**4**.

[0056] Further, the first temperature detection unit **43** detects the first temperature of the first semiconductor gauge **41** and transfers the first temperature to the smart sensor module **50**.

[0057] The first level amplification unit **48** includes a first amplification unit **45** for amplifying and outputting a difference value between the first and second voltage values and a first correction unit **47** for correcting a zero point of the first voltage difference value.

[0058] In the first amplification unit **45**, the first voltage value is supplies to a non-inversion terminal (−) and the second voltage value is supplied to an inversion terminal (+), and the first amplification unit **45** amplifies and outputs a difference value between the first and second voltage values.

[0059] The first correction unit **47** receives the first voltage difference value and the first zero point signal, corrects a zero point of the first voltage difference value based on the first zero point signal, and transfers the corrected zero point to the smart sensor module **50**.

[0060] The smart sensor module **50** includes a second sensing unit **54**, a second level amplification unit **58**, and a controller **59**.

[0061] The second sensing unit **54** includes a second semiconductor gauge **51** in which fifth, sixth, seventh, and eighth semiconductor resistors R**5**, R**6**, R**7**, and R**8** having varying resistance values are connected in a bridge form and a second temperature detection unit **53** for detecting a second temperature at the inside and the outside of the second semiconductor gauge **51**.

[0062] In the second semiconductor gauge **51**, power of the power supply unit **59_4** included in the smart sensor module **50** is supplied to a fifth contact point A**5** at which the fifth and seventh semiconductor resistors R**5** and R**7** are connected, a third voltage value is output to a sixth contact point A**6** at which the fifth and sixth semiconductor resistors R**5** and R**6** are connected, and a fourth voltage value is output to a seventh contact point A**7** at which the seventh and eighth semiconductor resistors R**7** and R**8** are connected, and an eighth contact point A**8** at which the sixth and eighth semiconductor resistors R**6** and R**8** are connected is connected to the ground.

[0063] The third voltage value is a voltage output at the sixth contact point A**6**, i.e. between the fifth and sixth semiconductor resistors R**5** and R**6**, and the fourth voltage value is a voltage output at the seventh contact point A**7**, i.e. between the seventh and eighth semiconductor resistors R**7** and R**8**.

[0064] Further, the second temperature detection unit **53** detects the second temperature of the second semiconductor gauge **51** and transfers the second temperature to the controller **59**.

[0065] The second level amplification unit **58** includes a second amplification unit **55** for amplifying and outputting a difference value between the third and fourth voltage values and a second correction unit **57** for correcting a zero point of the second voltage difference value.

[0066] In the second amplification unit **55**, the third voltage value is supplied to a non-inversion terminal (−) and the fourth voltage value is supplied to an inversion terminal (+), and the second amplification unit **55** amplifies and outputs a difference value between the third and fourth voltage values.

[0067] The second correction unit **57** receives the second voltage difference value and the second zero point signal, corrects a zero point of the second voltage difference value based on the second zero point signal, and transfers the zero point to the controller **59**.

[0068] The first and second semiconductor gauges **41** and **51** are formed in a chip form, and the first and second temperature detection units **43** and **53** can detect a temperature change in a chip surface of each of the first and second semiconductor gauges **41** and **51**.

[0069] As shown in FIG. **2**, the controller **59** includes a calculation unit **59_1**, a zero point adjustment unit **59_2**, and a determination unit **59_3**.

[0070] The calculation unit **59_1** has a lookup table in which a correction value for temperature change amount based on a reference temperature, compensates temperature through the lookup table, and calculates a final weight.

[0071] The zero point adjustment unit **59_2** outputs the first and second zero point signals to the first and second correction units **47** and **57** in order to correct zero points of the first and second voltage difference values.

[0072] The determination unit **59_3** determines, if the final weight satisfies the setting reference, that the passenger is detected and determines, if the final weight does not satisfy the setting reference, that the passenger is not detected.

[0073] As described above, a passenger detection device of an automobile can easily detect a passenger's weight and includes a smart sensor module including a controller for calculating a final weight of the passenger, determining whether a passenger is detected according to a setting reference, and classifying the passenger according to the setting reference, and thus calculates a final weight in which a temperature error is corrected through a temperature of first and second semiconductor gauges included in a weight sensor module and the smart sensor module, so that the quantity of circuit components can be reduced, and thus a cost can be reduced and a process can be improved.

[0074] The embodiment of the invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

1-10. (canceled)

11. A passenger detection device of an automobile, comprising:
- a weight sensor module for detecting a first voltage difference value and a first temperature at a first point of a seat; and
- a smart sensor module for detecting a second voltage difference value and a second temperature at a second point of the seat, calculating a final weight according to preset temperature correction values corresponding to the first and second temperatures and the first and second voltage difference values, and detecting a passenger by comparing the final weight and a reference setting.

12. The passenger detection device of claim **11**, wherein the weight sensor module comprises:
- a first sensing unit for detecting first and second voltage values and the first temperature at the first point; and
- a first level amplification unit for outputting the first voltage difference value, which is a difference value between the first and second voltage values, and correcting a zero point of the first voltage difference value.

13. The passenger detection device of claim **12**, wherein the first level amplification unit comprises:
- a first amplification unit for amplifying the difference value between the first and second voltage values and outputting the first voltage difference value; and
- a first correction unit for correcting and outputting a zero point of the first voltage difference value.

14. The passenger detection device of claim **12**, wherein the first sensing unit comprises:
- a first semiconductor gauge for detecting the first and second voltage values; and
- a first temperature detection unit for detecting the first temperature at one of the inside and the outside of the first semiconductor gauge.

15. The passenger detection device of claim **14**, wherein in the first semiconductor gauge, first, second, third, and fourth semiconductor resistors having varying resistance values are connected in a bridge form, and power is supplied to a first contact point at which the first and third semiconductor resistors are connected, the first voltage value is output to a second contact point at which the first and second semiconductor resistors are connected, the second voltage value is output to a third contact point at which the third and fourth semiconductor resistors are connected, and a fourth contact point at which the second and fourth semiconductor resistors are connected is connected to the ground.

16. The passenger detection device of claim **11**, wherein the smart sensor module comprises:
- a second sensing unit for detecting third and fourth voltage values and the second temperature at the second point;
- a second level amplification unit for outputting the second voltage difference value, which is a difference value between the third and fourth voltage values and correcting a zero point of the second voltage difference value; and
- a controller for calculating a final weight based on the first and second voltage difference values, detecting a passenger by comparing the final weight and the reference setting, and supplying first and second zero point signals to the first and second level amplification units, respectively, in order to correct zero points of the first and second voltage difference values.

17. The passenger detection device of claim **16**, wherein the second level amplification unit comprises:
- a second amplification unit for amplifying and outputting the second voltage difference value, which is a difference value between the third and fourth voltage values; and
- a second correction unit for correcting and outputting the zero point of the second voltage difference value.

18. The passenger detection device of claim **16**, wherein the second sensing unit comprises:
- a second semiconductor gauge for detecting the third and fourth voltage values; and
- a second temperature detection unit for detecting the second temperature at one of the inside and the outside of the second semiconductor gauge.

19. The passenger detection device of claim **18**, wherein in the second semiconductor gauge, fifth, sixth, seventh, and eighth semiconductor resistors having varying resistance values are connected in a bridge form, and power is supplied to a fifth contact point at which the fifth and seventh semiconductor resistors are connected, the third voltage value is output to a sixth contact point at which the fifth and sixth semiconductor resistors are connected, the fourth voltage value is output to a seventh contact point at which the seventh and eighth semiconductor resistors are connected, and an eighth contact point at which the sixth and eighth semiconductor resistors are connected is connected to the ground.

20. The passenger detection device of claim **16**, wherein the controller comprises:
- a calculation unit for calculating the final weight through a lookup table having at least one temperature correction value, which is a value for compensating temperature change amount based on a reference temperature;
- a zero point adjustment unit for supplying the first and second zero point signals corresponding to the first and second voltage difference values to the first and second level amplication units; and
- a determination unit for comparing the final weight with the reference setting and determining whether the passenger is detected.

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