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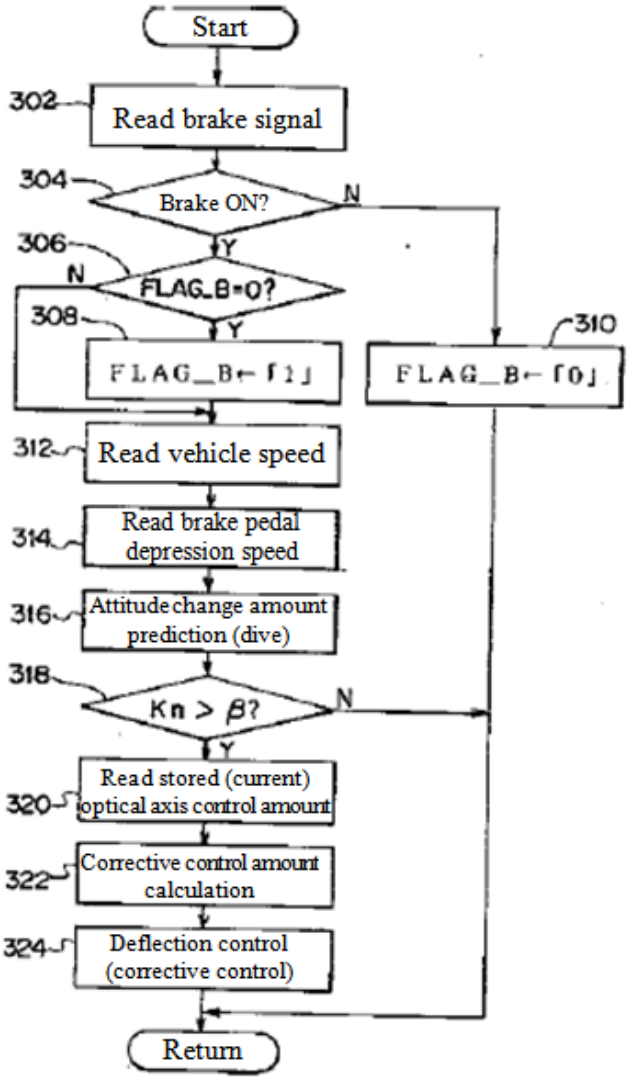
(54) [Title of Invention] Vehicle headlamp device

(57) [Abstract]
[Purpose] To ensure an optimal field of vision of a driver despite an attitude change of a vehicle due to a vehicle speed or the like.
[Constitution] When a brake is OFF, normal light distribution control is performed (302, 304, 310). When the brake is ON (306, 308), a current vehicle speed of a vehicle 10 is read (312), and a brake pedal depression speed is detected by a brake depression speed sensor (314). An attitude displacement amount of the vehicle 10 corresponding to the vehicle speed and the brake pedal depression speed is predicted by referencing a map (316). When the predicted attitude displacement amount exceeds a setting value (318), a stored optical axis control amount is read (320), a corrective optical axis control amount is calculated from the optical axis control amount according to the vehicle speed and the predicted attitude displacement amount (322), and an optical axis of the headlamp is deflected according to the calculated corrective optical axis control amount (324).



[Claims]
[Claim 1] A vehicle headlamp device, comprising:
a vehicle speed sensor that detects a vehicle speed of a vehicle having a headlamp that can control at least a brightness, an irradiation direction, or an irradiation range;
an operation amount detection means that detects an operation amount of the vehicle;
an attitude change amount prediction means that predicts an attitude change amount of the vehicle based on the vehicle speed and the operation amount; and
a control means that controls at least the brightness, the irradiation direction, or the irradiation range of the headlamp based on the predicted attitude change amount.
[Detailed Description of Invention]
[0001]
[Industrial Field of Application] The present invention relates to a vehicle headlamp device and specifically relates to a vehicle headlamp device that controls a light distribution of a headlamp that irradiates an area in front of a vehicle.
[0002]
[Conventional Art] With vehicles, a headlamp is provided at approximately a leading edge of a vehicle to improve a visibility of an area in front of a driver at night or the like. Recently, there are vehicle forward illumination devices that change an irradiation optical axis and an irradiation range of a headlamp according to a steering angle or the like for ensuring a field of vision of a driver (JPS55-22299B2, JPH2-27938U, JPH1-293247A, and the like).
[0003] Incidentally, a gaze position of the driver changes when a vehicle speed or the vehicle accelerates or decelerates. That is, the driver views an area farther away when the vehicle is accelerating and views an area more nearby when decelerating. Because of this, to ensure the field of vision, there is a need to change irradiation states such as the irradiation optical axis and the irradiation range of the headlamp according to the acceleration or the deceleration of the vehicle speed or the vehicle. Because of this, there is a headlamp irradiation angle adjustment device as a vehicle headlamp device that changes an irradiation angle of a headlamp to an appropriate irradiation angle by detecting acceleration and deceleration and ensuring a field of vision that is farther away when accelerating and ensuring a field of vision that is more nearby when decelerating (JPS63-131839U).
[0004]
[Problem to be Solved by Invention] However, the vehicle gives rise to an attitude change (a so-called “squat”) that raises a front part of the vehicle when accelerating and gives rise to an attitude change (a so-called “dive”) that raises a rear part of the vehicle when decelerating. Because of this, if the irradiation angle of the headlamp is changed to the appropriate irradiation angle to ensure the field of vision of the driver by the conventional vehicle headlamp device when the vehicle is accelerating or decelerating as above, the irradiation angle of the headlamp is changed so as to irradiate an area farther away than the appropriate irradiation angle due to squatting when accelerating and the irradiation angle of the headlamp is changed so as to irradiate an area even more nearby than the appropriate irradiation angle due to diving when decelerating. In this manner, there is a problem where an area in front of the vehicle cannot be appropriately irradiated by a light of the headlamp due to the attitude changes of the vehicle.
[0005] In consideration of the facts above, the present invention has as an object to obtain a vehicle headlamp device that can ensure an optimal field of vision of a driver despite an attitude change of a vehicle due to a vehicle speed or the like.

[0006]
[Solution to Problem] To achieve the object above, a vehicle headlamp device of the present invention is provided with a vehicle speed sensor that detects a vehicle speed of a vehicle having a headlamp that can control at least a brightness, an irradiation direction, or an irradiation range; an operation amount detection means that detects an operation amount of the vehicle; an attitude change amount prediction means that predicts an attitude change amount of the vehicle based on the vehicle speed and the operation amount; and a control means that controls at least the brightness, the irradiation direction, or the irradiation range of the headlamp based on the predicted attitude change amount.
[0007]
[Operation] According to the present invention, the headlamp of the vehicle can control at least the brightness, the irradiation direction, or the irradiation range. The vehicle speed of this vehicle is detected by the vehicle speed sensor. The operation amount detection means detects the operation amount of the vehicle. As this operation amount of the vehicle, there is a depression position of a brake pedal, a depression speed, a throttle opening, a rising speed of a brake fluid pressure, a steering angle, a steering angle speed, and the like. The attitude change amount prediction means predicts the attitude change amount of the vehicle based on the vehicle speed and the operation amount. Note that with the attitude change amount of the vehicle, an attitude change amount from a reference attitude of the vehicle may be obtained. With this reference attitude, there is an attitude of the vehicle when running on level ground at a constant speed as well as a situation of being offset according to a carried load of the vehicle. Here, an attitude of the vehicle changes greatly if a change in the vehicle speed is sudden but changes little if the change in the vehicle speed is slow. This change of the vehicle speed can be determined according to an operation indication amount of the driver by the depression position or the depression speed of the brake pedal. Therefore, if the control means controls at least the brightness, the irradiation direction, or the irradiation range of the headlamp based on the attitude change amount of the vehicle predicted based on the vehicle speed and the operation amount by the attitude change amount prediction means, the optimal field of vision of the driver can be ensured even if an attitude change of the vehicle occurs. For example, when accelerating, an attitude change amount where a front part of the vehicle rises can be predicted, and when decelerating, an attitude change amount where a rear part of the vehicle rises can be predicted. Because of this, when controlling at least the brightness, the irradiation direction, or the irradiation range of the headlamp, because at least one control amount from among the brightness, the irradiation direction, or the irradiation range to be controlled increases when the attitude change of the vehicle is predicted by the vehicle speed and the operation amount, it is favorable to control at least the brightness, the irradiation direction, or the irradiation range of the headlamp so as to offset this control amount that increases.
[0008] Note that the control means may control the headlamp so at least the brightness, the irradiation direction, or the irradiation range of the headlamp in the predicted attitude change amount corresponds to at least the brightness, the irradiation direction, or the irradiation range in the reference attitude of the vehicle. In this situation, the attitude of the vehicle may be controlled by assuming a change in the attitude beyond the reference attitude.
[0009] Furthermore, because the attitude change amount of the vehicle is different with every vehicle due to suspension geometries and suspension properties, it is favorable to predict the attitude change amount of the vehicle in consideration of the suspension geometry and the

suspension property. By doing so, an individual optimal attitude change amount can be predicted for each vehicle.

[0010]

[Examples] Examples of the present invention will be described in detail below by referencing the drawings. A vehicle headlamp device of the present example is one where the present invention is applied to a situation of controlling a light distribution by a front headlamp of a vehicle 10 by deflecting an irradiation optical axis of the headlamp. As illustrated in FIG. 1, an engine hood 12 is disposed on an upper face portion of a front body 10A of the vehicle 10, and a front bumper 16 is fixed to both end portions in a vehicle width direction of a front end portion of the front body 10A. Headlamps 18, 20, which are a lateral pair (both end portions in the vehicle width direction), are disposed on an upper portion of this front bumper 16 and a lower portion of the front body 10A.

[0011] Furthermore, a windshield glass 14 is provided near a rear end portion of the engine hood 12. A room mirror 15 is provided in an upper portion of this window shield glass 14 and inside the vehicle 10, and a TV camera 22 that includes a nighttime detection optical system for taking images of an area in front of the vehicle is disposed near this room mirror 15. This TV camera 22 is of a configuration that can also take images of a dark portion in front of the vehicle while running at night by having a photomultiplier tube or the like and amplifying a weak light. The TV camera 22 is connected to an image processing device 48 (FIG. 4). The image processing device 48 is a device that image processes an image taken by the TV camera 22 based on signals input from the TV camera 22 and a control device 50. Note that a disposition position of the TV camera 22 is preferably positioned near a viewing position (a so-called "eye point") of the driver so as to enable accurately recognizing a road shape in front of the vehicle and so as to better match a visual sensation of the driver. Note that the road shape above includes a road shape corresponding to a shape of a path of travel, for example, one lane formed by a centerline, a curb, and the like.

[0012] A speed meter that is not illustrated is disposed in the vehicle 10, and a vehicle speed sensor 66 (FIG. 4) that detects a vehicle speed V of the vehicle 10 is installed on a cable that is not illustrated of this speed meter that is not illustrated. Moreover, on a brake pedal (illustration omitted) provided in the vehicle 10, a brake switch 74 that turns on when the brake pedal that is not illustrated is depressed is installed and a brake depression speed sensor 70 (FIG. 4) that detects a depression speed BV of the brake pedal that is not illustrated is installed. Note that the brake depression speed may be a rising speed of a brake fluid. Moreover, an accelerator switch 72 that turns on when a predetermined opening, which corresponds to an accelerator pedal being depressed, is reached or exceeded and an accelerator depression speed sensor 68 (FIG. 4) that detects a depression speed AV of the accelerator pedal that is not illustrated by detecting an opening and closing speed of a throttle bulb that is not illustrated are installed on a throttle bulb (illustration omitted) that regulates a flow rate of fuel.

[0013] As illustrated in FIG. 2, the headlamp 18 is a headlamp of a projector type and has a convex lens 30, a bulb 32, and a lamp housing 34. The convex lens 30 is fixed in one opening of this lamp housing 34, and the bulb 32 is fixed in another opening thereof via a socket 36 so a luminous point is positioned on an optical axis C of the convex lens 30 (center axis of the convex lens 30).

[0014] A bulb side inside the lamp housing 34 is made to be a reflector 38 of an ellipsoidal reflective surface, and a light from the bulb 32 reflected by this reflector 38 is condensed between the convex lens 30 and the bulb 32. An upper end of a shade 40 (see FIG. 3) is fixed so as to be positioned near this condensing point. A shape of this shade 40 is determined in advance for driver visibility improvement of a pedestrian, a sign, and the like and for preventing glaring to an

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