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(54) **VEHICLE MIRROR SELECTION BASED ON HEAD POSE AND GAZE DIRECTION**

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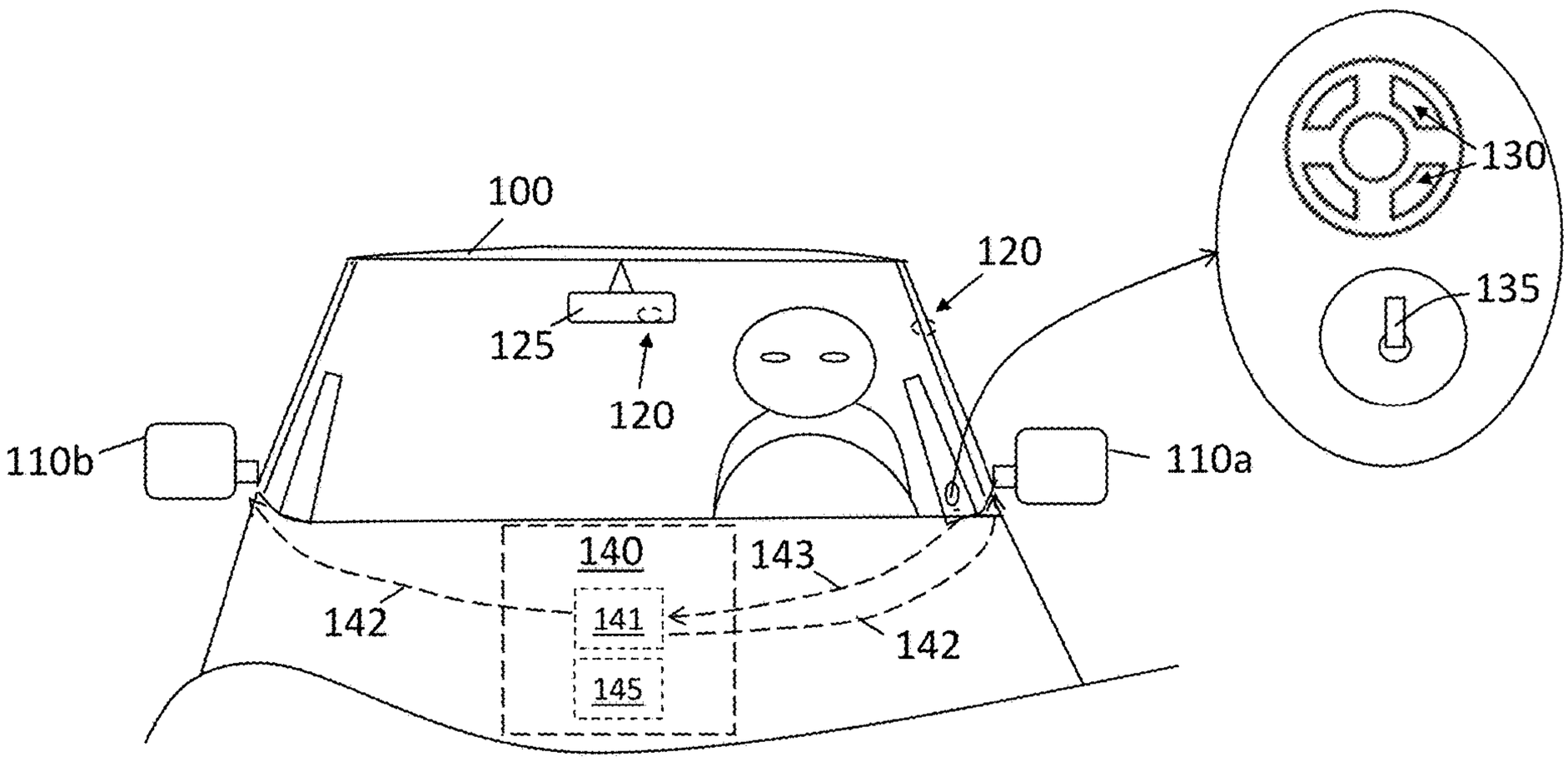
(57) **ABSTRACT**

A system in a vehicle includes processing circuitry to identify a selected side mirror by determining whether a driver is looking at a first side mirror or a second side mirror based on head pose or gaze direction detection. The system also includes an interface to control adjustment of a position of the selected side mirror based on driver input.



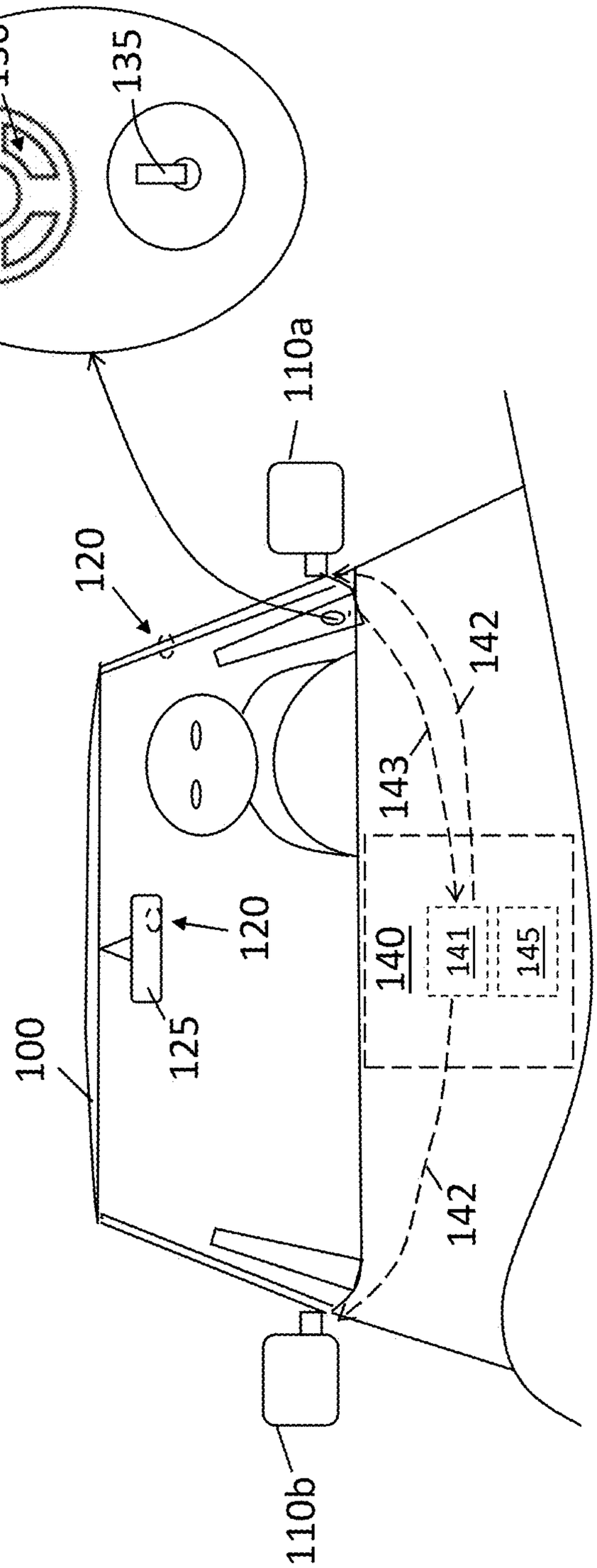


FIG. 1

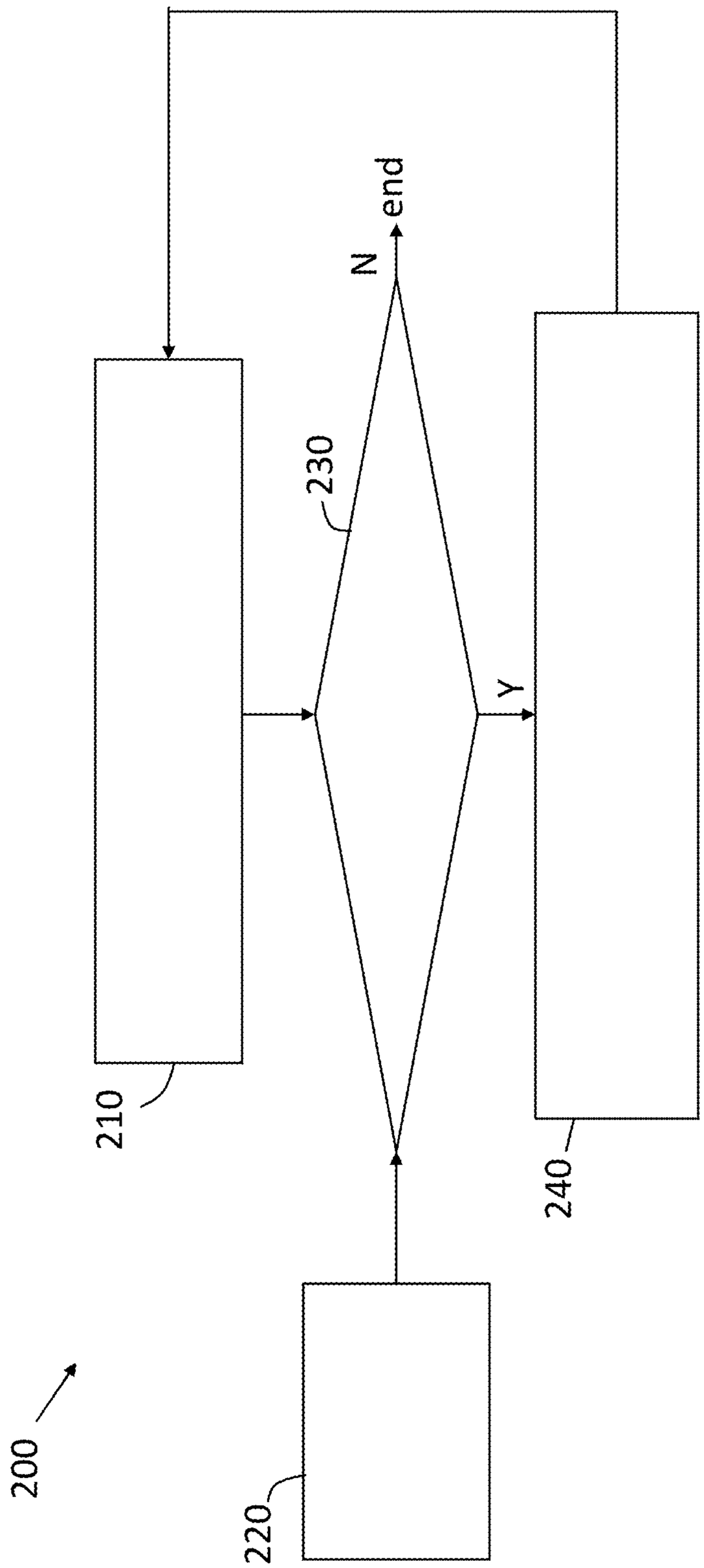


FIG. 2

VEHICLE MIRROR SELECTION BASED ON HEAD POSE AND GAZE DIRECTION

INTRODUCTION

[0001] The subject disclosure relates to vehicle mirror selection based on head pose and gaze direction.

[0002] In a vehicle (e.g., automobile, truck, construction equipment, farm equipment), the rearview and side mirrors increase the field of view of the driver and facilitate avoiding collisions. The side mirrors can prevent a lane change into traffic, for example. However, when a different driver enters a vehicle or a driver changes a previous seating position, adjustment of the mirrors to provide the correct view is essential to maximizing the utility of the mirrors. Accordingly, it is desirable to provide vehicle mirror selection based on head pose and gaze direction.

SUMMARY

[0003] In one exemplary embodiment, a system in a vehicle includes processing circuitry to identify a selected side mirror by determining whether a driver is looking at a first side mirror or a second side mirror based on head pose or gaze direction detection. The system also includes an interface to control adjustment of a position of the selected side mirror based on driver input.

[0004] In addition to one or more of the features described herein, the processing circuitry identifies the selected side mirror in response to obtaining the driver input.

[0005] In addition to one or more of the features described herein, the driver input is an operation of a directional control button.

[0006] In addition to one or more of the features described herein, the directional control button is one of a plurality of directional control buttons to control the adjustment of the position of the selected side mirror.

[0007] In addition to one or more of the features described herein, the driver input is an operation of a joystick.

[0008] In addition to one or more of the features described herein, the processing circuitry identifies the selected side mirror using one or more cameras directed at a face of the driver.

[0009] In addition to one or more of the features described herein, the processing circuitry iteratively identifies the selected side mirror and controls the adjustment of the position of the selected side mirror for each driver input.

[0010] In addition to one or more of the features described herein, the interface provides a control signal to the selected side mirror based on the driver input to control the adjustment of the position of the selected side mirror.

[0011] In another exemplary embodiment, a method in a vehicle includes configuring processing circuitry to identify a selected side mirror by determining whether a driver is looking at a first side mirror or a second side mirror based on head pose or gaze direction detection. The method also includes configuring an interface to control adjustment of a position of the selected side mirror based on driver input.

[0012] In addition to one or more of the features described herein, the configuring the processing circuitry includes the processing circuitry identifying the selected side mirror in response to obtaining the driver input.

[0013] In addition to one or more of the features described herein, the driver input is an operation of a directional control button.

[0014] In addition to one or more of the features described herein, the directional control button is one of a plurality of directional control buttons to control the adjustment of the position of the selected side mirror.

[0015] In addition to one or more of the features described herein, the driver input is an operation of a joystick.

[0016] In addition to one or more of the features described herein, the configuring the processing circuitry includes the processing circuitry identifying the selected side mirror using one or more cameras directed at a face of the driver.

[0017] In addition to one or more of the features described herein, the configuring the processing circuitry includes the processing circuitry iteratively identifying the selected side mirror and controlling the adjustment of the position of the selected side mirror for each driver input.

[0018] In addition to one or more of the features described herein, the configuring the interface includes the interface providing a control signal to the selected side mirror based on the driver input to control the adjustment of the position of the selected side mirror.

[0019] The above features and advantages, and other features and advantages of the disclosure are readily apparent from the following detailed description when taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] Other features, advantages and details appear, by way of example only, in the following detailed description, the detailed description referring to the drawings in which:

[0021] FIG. **1** shows aspects of a vehicle that includes vehicle mirror selection based on head pose and gaze direction; and

[0022] FIG. **2** is a process flow of a method of performing vehicle mirror selection based on head pose and gaze direction according to one or more embodiments.

DETAILED DESCRIPTION

[0023] The following description is merely exemplary in nature and is not intended to limit the present disclosure, its application or uses. It should be understood that throughout the drawings, corresponding reference numerals indicate like or corresponding parts and features.

[0024] As previously noted, the rearview mirror and side mirrors can expand the field of view of a driver and thereby improve safety. As also noted, the mirrors must be adjusted for each driver and each driving position in order to maximize their utility. Adjusting the position of a rearview mirror is straight-forward, because a driver can simply reach up and make a manual adjustment but adjusting the side mirrors is less simple due to their placement on the exterior of the vehicle and the distance of one of the side mirrors from the driver. Electrically adjustable side mirrors, referred to as power mirrors, addressed this inconvenience by allowing adjustment of the side mirror positions with directional control buttons. Prior power side mirrors additionally include a power mirror switch that allows selection of one of the side mirrors so that only the selected mirror is moved based on pressing the directional control buttons. This adds an expense to the mirror adjustment mechanism that is associated with an additional button and associated wiring.

[0025] Embodiments of the systems and methods detailed herein relate to vehicle mirror selection based on head pose and gaze direction. Many vehicles include one or more

cameras to track the head pose, indicating the direction that a face is turned, and gaze direction, indicating a direction in which one or both eyes of the driver are focused. The images may be used to determine driver alertness, for example. That is, the head pose and gaze direction, alone or in conjunction with other sensor information, may indicate whether the driver has fallen asleep (e.g., eyes are closed) or is distracted (e.g., head and eyes looking down), for example. The determination may result in an alert being issued to the driver, for example. The side mirror selection, according to one or more embodiments, takes advantage of the availability of the head pose and gaze direction in the vehicle to eliminate the mirror selection button.

[0026] In accordance with an exemplary embodiment, FIG. **1** shows aspects of a vehicle **100** that includes vehicle mirror selection based on head pose and gaze direction. The vehicle **100** is shown with side mirrors **110***a*, **110***b* (generally referred to as **110**), a rear-view mirror **125**, directional control buttons **130**, and a controller **140**. A driver is shown on one side of the vehicle **100** such that the side mirror **110***a* is the driver-side mirror. However, in a different vehicle, the driver may be seated on the opposite side such that the side mirror **110***b* is the driver-side mirror. An exemplary camera **120** is shown in the rear-view mirror **125**. Another exemplary camera **120** is shown in a side pillar of the vehicle **100**. One or more additional or alternate cameras **120** may be positioned in different areas, and the one or more cameras **120** may be directed to the face of the driver to facilitate head pose and/or gaze direction detection.

[0027] Four exemplary directional control buttons **130** or a joystick **135** are shown located on an armrest of a vehicle door panel. The four directional control buttons **130** or joystick **135** may facilitate providing input **143** to move a selected one of the side mirrors **110** up or down and to one side or the other. According to alternate embodiments, additional directional control buttons **130** (i.e., providing more than four directions for movement of the side mirrors **110**) may be provided and may be located elsewhere within the vehicle **100**. In addition, functionality of the directional control buttons **130** may be included in an infotainment system of the vehicle **100** via a touchscreen, for example. The controller **140** may perform the head pose and/or gaze direction determination and control the selected side mirror **110** according to the input **143** via operation of the directional control buttons **130** or joystick **135**. The controller **140** may additionally control aspects of vehicle operation.

[0028] The controller **140** may include processing circuitry **145** that may include an application specific integrated circuit (ASIC), an electronic circuit, a processor (shared, dedicated, or group) and memory that executes one or more software or firmware programs, a combinational logic circuit, and/or other suitable components that provide the described functionality. As shown, the controller **140** includes an interface **141** to receive input **143** based on operation of the directional control buttons **130** or joystick **135**. The processing circuitry **145** may determine which of the side mirrors **110** is selected for adjustment using head pose and/or gaze direction, according to one or more embodiments. Then, the interface **141** may send a control signal **142**, directly or via additional processors, to the selected side mirror **110** to implement a position change based on the input **143**. The interface **141** may include wiring or wireless communication according to alternate embodiments.

[0029] FIG. **2** is a process flow of a method **200** of performing vehicle mirror selection based on head pose and gaze direction according to one or more embodiments. The processes may be performed by the controller **140**. At block **210**, receiving input at one of the directional control buttons **130** or via the joystick **135** is a trigger for the method **200**. At block **220**, head pose and/or eye gaze detection are performed. These processes may be performed continually for different purposes such as driver alertness monitoring, as previously noted.

[0030] Specifically, one or more cameras **120** may be used, according to known processes, to detect the position of the driver's head and/or the direction in which the eyes are looking. When both head pose and gaze direction are obtained, the combination of the head pose and eye gaze may be used to ascertain what the driver is looking at. A trained machine learning algorithm or other known approach may be used to determine where the driver is looking based on head pose and/or gaze direction.

[0031] At block **230**, a check is done of whether the driver is looking at one of the side mirrors **110**. As FIG. **2** indicates, this check is only performed after an input is received from one of the directional control buttons **130** or via the joystick **135**. Thus, the driver's looking at one of the side mirrors **110** alone would not result in any adjustments. If the check at block **230** indicates that the driver is not looking at one of the side mirrors **110**, then the processes end until the driver operates one of the directional control buttons **130** or the joystick **135** again to trigger the method **200**. Thus, accidental operation of a directional control button **130** or the joystick **135** would not result in any adjustments.

[0032] If the check at block **230** indicates that the driver is looking at one of the side mirrors **110**, then, at block **240**, the input received via the directional control button **130** or the joystick **135** is applied to the side mirror **110** at which the driver is looking. For example, if the driver presses the "up" directional control button **130** or pushes the joystick **135** up while looking at the side mirror **110***b*, then the press of the "up" directional control button **130** or push of the joystick **135** would serve as the trigger at block **210**, the check at block **230** would confirm that that the driver was looking at the side mirror **110***b*, and, thus, the side mirror **110***b* would be controlled to move up from its current position, at block **240**.

[0033] As FIG. **2** indicates, the processes are iterative. Thus, as long as the driver keeps providing an input via one of the directional control buttons **130** or the joystick **135** to provide the trigger at block **210** and as long as the driver keeps looking at one of the side mirrors **110** to pass the check at block **230**, the side mirror **110** indicated by the check at block **230** will be adjusted, at block **240**, according to the input via the directional control button **130** or joystick **135**. As previously noted, applying the directional control button **130** or joystick **135** input, at block **240**, to adjust the selected side mirror **110** may include the controller **140** sending a control signal **142** from an interface **141** to the selected side mirror **110**.

[0034] While the above disclosure has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from its scope. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the disclosure without departing

from the essential scope thereof. Therefore, it is intended that the present disclosure not be limited to the particular embodiments disclosed, but will include all embodiments falling within the scope thereof.

What is claimed is:

1. A system in a vehicle, the system comprising:

processing circuitry configured to identify a selected side mirror by determining whether a driver is looking at a first side mirror or a second side mirror based on head pose or gaze direction detection; and

an interface configured to control adjustment of a position of the selected side mirror based on driver input.

2. The system according to claim **1**, wherein the processing circuitry is configured to identify the selected side mirror in response to obtaining the driver input.

3. The system according to claim **2**, wherein the driver input is an operation of a directional control button.

4. The system according to claim **3**, wherein the directional control button is one of a plurality of directional control buttons configured to control the adjustment of the position of the selected side mirror.

5. The system according to claim **2**, wherein the driver input is an operation of a joystick.

6. The system according to claim **1**, wherein the processing circuitry is configured to identify the selected side mirror using one or more cameras directed at a face of the driver.

7. The system according to claim **1**, wherein the processing circuitry is configured to iteratively identify the selected side mirror and to control the adjustment of the position of the selected side mirror for each driver input.

8. The system according to claim **1**, wherein the interface is configured to provide a control signal to the selected side mirror based on the driver input to control the adjustment of the position of the selected side mirror.

9. A method in a vehicle, the method comprising:

configuring processing circuitry to identify a selected side mirror by determining whether a driver is looking at a first side mirror or a second side mirror based on head pose or gaze direction detection; and

configuring an interface to control adjustment of a position of the selected side mirror based on driver input.

10. The method according to claim **9**, wherein the configuring the processing circuitry includes the processing circuitry identifying the selected side mirror in response to obtaining the driver input.

11. The method according to claim **10**, wherein the driver input is an operation of a directional control button.

12. The method according to claim **11**, wherein the directional control button is one of a plurality of directional control buttons configured to control the adjustment of the position of the selected side mirror.

13. The method according to claim **10**, wherein the driver input is an operation of a joystick.

14. The method according to claim **9**, wherein the configuring the processing circuitry includes the processing circuitry identifying the selected side mirror using one or more cameras directed at a face of the driver.

15. The method according to claim **9**, wherein the configuring the processing circuitry includes the processing circuitry iteratively identifying the selected side mirror and controlling the adjustment of the position of the selected side mirror for each driver input.

16. The method according to claim **9**, wherein the configuring the interface includes the interface providing a control signal to the selected side mirror based on the driver input to control the adjustment of the position of the selected side mirror.

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