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S P E C I F I C A T I O N

TITLE OF THE INVENTION

Projection Type Display System

TECHNICAL FIELD

The present invention relates to a projection type display system and, more particularly, to a projection type display system for an enlarged projection on a screen through a projection lens by modulating a light by a liquid crystal panel in accordance with video data. Especially, the present invention relates to a small-sized highly portable projection type display system using a liquid crystal panel.

BACKGROUND ART

In the small-sized highly portable projection type display system (e.g., the projection type display system using a liquid crystal panel as optical modulation means), the projection lens has its focal length adjusted either manually by mechanical means or automatically by an electric motor operated by a switch, because the distance between the projection type display system and a screen changes each time the place

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of the display system changes.

Here will be specifically described the background art with reference to Fig. 8.

Fig. 8 is a diagram showing the structure of a focusing mechanism for adjusting the focal point of a projection lens by an electric motor operated by a switch.

If an operation switch 504 is depressed, pulses having a width proportional to the time period for the time depression are generated from a motor drive signal generator 502. As a result, a projection lens drive motor 501 drives a projection lens 505 for the time period of the pulse width so that the projection lens 505 is driven toward a screen 507 to change the focal length.

If an operation switch 503 is depressed, the projection lens 505 is driven by the operations like the aforementioned ones apart from the screen 507 to change the focal length.

By the operations thus far described, the operation switches 503 and 504 are operated to move the projection lens 505 to adjust the distance between the projection lens 505 and the screen 507 to a value equal to the focal length of the projection lens 505. As a result, the light having been modulated by an op-

tical modulation block 506 in accordance with video signals is clearly projected on the screen 507 in an enlarged scale by the projection lens 505. Reference numeral 508 designates a power supply for the motor drive signal generator 502.

Since the focal adjustment is accomplished by depressing the operation switches 503 and 504, according to this background art, the depressions are continued to the vicinity of the optimum focal adjustment while observing the image focused on the screen 507. After this, the projection lens forward operation switch 504 and the backward operation switch 503 are also depressed several times up to the optimum focal point while the image focused on the screen 507 being observed. This troubles the operations because the depressions of the operations switches 503 and 504 are required several times till the end of setting the optical focal point.

In case a user of poor visibility adjusts the focal point, the background art finds it difficult to achieve the optical focal point because he has to accomplish the adjustment because he has to observe the image focused on the screen 507.

DISCLOSURE OF THE INVENTION

The present invention has been conceived in view of the problems thus far described and has an object to facilitate the focal adjustment of a projection type display system thereby to improve the precision of setting the optimum focal point.

In order to achieve the above-specified object, according to the present invention, there is provided a projection type display system which comprises: optical modulation means for modulating a light in accordance with video data; a projection lens system for projecting the modulated light on a screen; and focal adjustment means for the projection lens system for adjusting the focal state of the image focused on the screen, wherein the improvement resides in that said focal adjustment means includes a range finding unit for finding the distance between the projection lens and the screen with an invisible light, and automatic adjustment means for adjusting the focal point of the projection lens system at an optimum focal point.

Thanks to the provision of the automatic focal adjustment means, the optimum focal point can be set by adjusting the focal point automatically without any trouble of the user each time the projection type display system is moved. As a result, the focal adjusting operations can be drastically facilitated to im-

prove the precision of setting the optimum focal point.

If the projection type display system further comprises a pattern display unit for displaying a fixed pattern at the end of the focal adjustment when the automatic focusing means stops, the user can easily confirm the instant of ending the operation of the automatic focusing means to improve the operability of the focal adjustment.

If, moreover, the aforementioned pattern display unit is replaced by one for displaying a first fixed pattern during the focal adjustment while the automatic focal adjustment means is in operation and a second fixed pattern at the end of the focal adjustment while the automatic focal adjustment means is not in operation, the operability of the focal adjustment is further improved because the user is enabled to confirm the operation of the automatic focal adjustment means easily by making different the fixed patterns displaced during and at the end of the operation of the automatic focal adjustment means.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 is a block diagram showing the structure of a projection type display system according to a

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first embodiment for exemplifying the projection type display system according to the present invention;

Fig. 2 is a diagram schematically showing the automatic focal adjustment to be applied to the projection type display system according to the first embodiment;

Fig. 3 is a diagram showing an infrared ray reception unit to be applied to the projection type display system according to the first embodiment;

Fig. 4 is a block diagram showing the structure of a projection type display system according to a second embodiment for exemplifying the projection type display system according to the present invention;

Fig. 5 is a diagram showing a focal adjustment fixed pattern to be applied to the projection type display system according to the second embodiment;

Fig. 6 is a block diagram showing the structure of a projection type display system according to a third embodiment for exemplifying the projection type display system according to the present invention;

Figs. 7A and 7B are diagrams showing two kinds of focal adjustment fixed patterns to be applied to the projection type display system according to the third embodiment; and

Fig. 8 is a block diagram showing the projection

type display system according to the background art of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

The present invention will be described in the following in connection with the embodiments thereof with reference to Figs. 1 to 7. Incidentally, the same components in the description are designated at the identical reference characters, and the overlapped description will be omitted.

First of all, the projection type display system according to the first embodiment of the present invention will be described with reference to Figs. 1 to 3. In the present embodiment, the automatic focal adjustment mechanism is constructed to adjust the focal length of a projection lens by finding the distance between the projection lens and the screen with an infrared ray. Specifically, the distance between a projection lens 103 and a screen 108 is found by emitting the infrared ray from an infrared ray emission unit 107 and by receiving the emitted infrared ray by an infrared ray reception unit 106. In accordance with the found distance, moreover, a drive signal is issued from an AF.CONT.IC (i.e., auto-focus control IC) 102 to drive the focal adjustment motor 101. In response

to this drive signal, the projection lens 103 is moved forward or backward to effect such an automatic adjustment that the distance between the projection lens and the screen may be equalized to the focal length of the projection lens. As a result, the light is modulated in an optical modulation block 104 in accordance with the video data and is projected in an enlarged scale by the projection lens 103 so that it is clearly focused on the screen 108. Incidentally, the AF.CONT. IC 102 is connected with a power supply 105 so that it is supplied with a drive voltage.

Next, the operation principles of the automatic adjustment mechanism to be applied to the present embodiment will be described with reference to Figs. 2 and 3. An infrared ray emitted from an infrared emission unit 203 is reflected by a screen 201 or a screen 202. Here, the screen 201 is located where the focal point is adjusted to the optimum, whereas the screen 202 is located in a position out of focus. The infrared rays thus reflected by those screens 201 and 202 are so deflected by a parallel prism 205 that they are received by an infrared ray reception unit 206. A drive signal for a focal adjustment motor 207 is generated in accordance with the spot positions of the infrared rays received on the infrared ray reception

unit 206.

This infrared ray reception unit is divided, as shown in Fig. 3, into two areas, i.e., an area A 301 and an area B 302. If the focal length is automatically adjusted to the optimum position, the infrared ray spots extend evenly over the area A 301 and the area B 302 and are located at a spot position 303. If out of focus, on the contrary, the infrared ray spot position is offset to the area A 301 or the area B 302, as indicated at a spot position 304. As a matter of fact, the reception unit itself is composed of a photo-electric conversion element or the like so that it generates an electric signal in proportion to the level of the infrared ray received. As a result, the AF.CONT.IC 102 can generate a drive signal for the focus adjustment motor 207 on the basis of the infrared ray received by the infrared ray reception unit. For example, the focus adjustment motor drive signal is generated to move the projection lens 304 forward, if the ray is received at the area A 301, and to move the projection lens 304 backward if the ray is received at the area B 302. Thus, the infrared ray spot extends evenly, as indicated at the spot position 303, over the area A 301 and the area B 302 so that the focus is automatically adjusted by moving the projec-

tion lens 304 forward or backward till the optimum focal point is achieved by balancing the focal adjustment motor drive signal for moving the projection lens 304 forward and the focal adjustment motor drive signal for moving the projection lens 304 backward.

Thus, a projection lens 204 is moved back and forth by the focus adjustment motor 207 so that its focal length is automatically adjusted to optimize the relation between the screen and the projection lens like the case of the screen 201 having the optimum focal point.

Next, a projection type display system according to the second embodiment of the present invention will be described with reference to Figs. 4 and 5. This embodiment is equipped, in addition to the structure of the first embodiment, with a character generator (e.g., a pattern display unit) capable of displaying one kind of fixed pattern so that the user can visually confirm the end of the operation of the auto-focus adjustment mechanism. The infrared ray is emitted from the infrared ray emission unit 107 and is received by the infrared ray reception unit 106. Thus, the distance between the projection lens 103 and the screen 108 is measured, and the drive signal for the focus adjustment motor 101 is generated from the AF.

CONT.IC 102 in accordance with the measured distance. The AF.CONT.IC 102 is connected with the power supply 105 so that it is supplied with the drive voltage. By the drive signal generated from the AF.CONT.IC 102, the focus adjustment motor 101 is driven to move the projection lens 103 forward or backward. As a result of this forward or backward movement of the projection lens 103, the auto-focusing is so effected that the distance between the projection lens 103 and the screen 108 may be equalized to the focal length of the projection lens 103. The principle of this automatic adjustment has been described hereinbefore. Therefore, the light having been modulated in the optical modulation block 104 in accordance with the video data is projected in an enlarged scale by the projection lens 103 and is focused on the screen 108. Moreover, a character generator (i.e., CG) 109 generates one kind of fixed pattern (as shown in Fig. 5), which is superimposed on the video data and displaced on the screen 108.

Next, a projection type display system according to the third embodiment of the present invention will be described with reference to Figs. 6 and 7. The present embodiment is equipped, in addition to the structure of the first embodiment, with a character

generator (e.g., a pattern display unit) capable of displaying two kinds of fixed patterns so that the user can visually confirm the in-operation state and the end state of the auto-focusing mechanism.

The distance between the projection lens 103 and the screen 108 is measured by emitting an infrared ray from the infrared ray emission unit 107 and by receiving it at the infrared ray receiving unit 106. In accordance with the measured distance, the AF.CONT.IC 102 generates the drive signal to drive the focal adjustment motor 101. This AF.CONT.IC 102 is connected with the power supply 105 so that it is supplied with the drive voltage. Since the projection lens 103 is moved forward or backward by the focal adjustment motor 101, the distance between the projection lens 103 and the screen 108 is so automatically adjusted that it is equalized to the focal length of the projection lens 103. As a result, the light having been modulated in the optical modulation block 104 in accordance with the video data is projected in an enlarged scale by the projection lens 103 and is projected on the screen 108. Reference characters CG-a 110 and CG-b 111 designate character generators, of which the former CG-a 110 generates a fixed pattern indicating that the auto-focusing mechanism is in

operation whereas the latter CG-b 111 generates a fixed pattern indicating that the auto-focusing mechanism has ended its operation. The fixed pattern data generated from the individual character generators are superimposed on the video data in the optical modulation block 103 and are displayed on the screen 108. The switching of those character generators CG-a 110 and CG-b 111 is accomplished in response to the signals which are generated from the AF.CONT.IC 102 for the different operations of the automatic adjustment mechanism.

Fig. 7A is a fixed pattern which is issued from the CG-a 110 to indicate that the auto-focusing mechanism is in operation, and Fig. 7B is a fixed pattern which is issued from the CG-b 111 to indicate that the auto-focusing mechanism has ended its operation. In case of the present embodiment, a pattern composed of offset upper and lower components is displayed on the screen 108, as shown in Fig. 7A, while the auto-focusing mechanism is in operation (because of being out of focus). At the end of the operation of the auto-focusing mechanism, on the other hand, a pattern having a complete shape is displayed on the screen 108, as shown in Fig. 7B.

INDUSTRIAL APPLICABILITY

As has been described hereinbefore, according to the present invention, the focal adjustment can be drastically simplified to set the optimum focal point automatically by providing the projection type display system with the auto-focusing mechanism, so that the precision of focal adjustment is drastically improved. Especially in case of the small-sized highly portable projection type display system using the liquid crystal panel as the optical modulation means, the focal adjustment occupies a large weight in the operation because the display system is portable. By adopting the structure of the present invention, therefore, there can be strongly appealed the merits that the operability and precision of the focal adjustment are remarkably improved and that the liquid crystal projection type display system is featured by the small size and the high portability.

In case of the fixed pattern, moreover, the user is enabled to easily know the focal state of the image on the screen by displaying the pattern indicating the end of the operation of the auto-focusing mechanism.

In this case, by displaying two kinds of different fixed patterns for indicating that the auto-focusing mechanism is in operation and has ended its

operation, the user is enabled to know the operational state of the auto-focusing mechanism easily from not only the focused state of the image on the screen but also the kind of the fixed pattern displayed.

By adopting the structure of the present invention, therefore, the operability of the focal adjustment can be drastically improved to enhance the additional value of the auto-focusing mechanism better.



CLAIMS

1. A projection type display system comprising:
optical modulation means for modulating a light
in accordance with video data;
a projection lens system having a projection lens
for projecting the modulated light on a screen; and
focal adjustment means for said projection lens
system for adjusting the focal state of the image fo-
cused on said screen,
wherein the improvement resides in that said fo-
cal adjustment means includes a range finding unit for
finding the distance between said projection lens and
said screen with an invisible light, and automatic ad-
justment means for adjusting the focal point of said
projection lens system at a desired position.
2. A projection type display system according to
Claim 1,
wherein said optical modulation means includes a
liquid crystal panel.
3. A projection type display system according to
Claim 1,
wherein said optical modulation means includes a





CRT.

4. A projection type display system according to Claim 1, wherein said invisible light is an infrared ray.

5. A projection type display system according to Claim 1,

wherein said range finding unit includes a light emitting element for irradiating said screen with said invisible light, and a light reception element having at least two divided light receiving areas for receiving the reflected light from said screen to output an electric signal corresponding to the light receiving position of said reflected light, and

wherein said automatic adjustment means includes distance changing means for changing the distance from said screen to said projection lens, and control means for sending such a control signal to said distance changing means that said reflected light may irradiate a desired position in said light receiving areas on the basis of the electric signal coming from said light reception element.

6. A projection type display system according to

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Claim 5,

wherein said distance changing means is a focal adjustment motor for moving said projection lens.

7. A projection type display system according to Claim 1,

wherein said automatic adjustment means further includes a pattern display unit for displaying a fixed pattern indicating that said automatic adjustment means has ended its focal adjustment on said screen such that it is superimposed over said video data.

8. A projection type display system according to Claim 7,

wherein said range finding unit includes a light emitting element for irradiating said screen with said invisible light, and a light reception element having at least two divided light receiving areas for receiving the reflected light from said screen to output an electric signal corresponding to the light receiving position of said reflected light, and

wherein said automatic adjustment means includes distance changing means for changing the distance from said screen to said projection lens, and control means for sending such a control signal to said distance



changing means that said reflected light may irradiate a desired position in said light receiving areas on the basis of the electric signal coming from said light reception element.

9. A projection type display system according to Claim 1,

wherein said automatic adjustment means further includes a pattern display unit for indicating a first fixed pattern for a focal adjustment period while it is in operation and a second fixed pattern on said screen in a manner to be superimposed on said video data when it has ended its focal adjustment.

10. A projection type display system according to Claim 9,

wherein said range finding unit includes a light emitting element for irradiating said screen with said invisible light, and a light reception element having at least two divided light receiving areas for receiving the reflected light from said screen to output an electric signal corresponding to the light receiving position of said reflected light, and

wherein said automatic adjustment means includes distance changing means for changing the distance from



said screen to said projection lens, and control means for sending such a control signal to said distance changing means that said reflected light may irradiate a desired position in said light receiving areas on the basis of the electric signal coming from said light reception element.