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(71) Applicant
LG Electronics Co., Ltd.
20 Yeouido-dong, Yeongdeungpo-gu, Seoul, Republic of Korea
(72) Inventor
Deok Young Jin
LG Electronics Digital Display Business Division, 642 Jinpyeong-dong, Gumi-si, Gyeongsangbuk-do
(74) Agents
Yong In Kim, **Young Bok Park**

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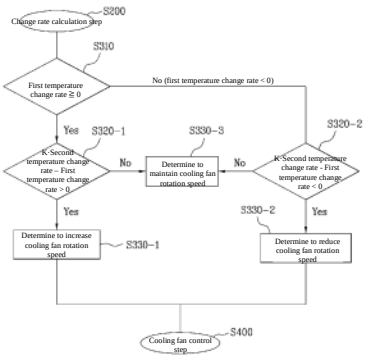
(54) PROJECTOR AND A METHOD OF CONTROLLING THE PROJECTOR

(57) Summary

The present invention relates to a projector having effective cooling performance and a method of controlling the projector. More specifically, the present invention relates to a projector and a method for controlling the projector, which can effectively control the rotation speed of a fan by predicting temperature changes inside the projector.

According to the projector and the method of controlling the projector according to this invention, the temperature change inside the projector can be predicted in advance, the temperature inside the projector can be effectively reduced, and noise generated by the cooling fan provided inside the projector can be minimized.

Representative Drawing - FIG. 4



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Scope of Claims

Claim 1

A method of controlling projector comprising: a temperature measuring step of measuring the temperature inside a projector housing at predetermined time intervals;

a temperature change rate calculation step of calculating a rate of change of the temperature measured in the temperature measuring step;

a cooling fan rotation speed determining step of determining a rotation speed of a cooling fan mounted inside the projector housing using the temperature change rate calculated in the temperature change rate calculation step; and,

a cooling fan control step of rotating the cooling fan at the rotation speed of the cooling fan determined in the cooling fan rotation speed determining step.

Claim 2

The method of controlling projector according to Claim 1,

characterized in that, the temperature measuring step measures the temperature at at least *n* timepoints;

the change rate calculation step calculates the temperature change rate between the final measurement timepoint and at least two timepoints excluding the final measurement timepoint; and

the cooling fan rotation speed determining step compares the change rates and determines the rotation speed of the cooling fan.

Claim 3

The method of controlling projector according to Claim 2,

characterized in that, the change rate calculation step calculates a second temperature change rate between the final measurement timepoint and a timepoint immediately before the final measurement timepoint and a first temperature change rate between the final measurement timepoint and a timepoint other than the timepoint immediately before the final measurement timepoint; and

the cooling fan rotation speed determining step determines the rotation speed of the cooling fan such that the rotation speed of the cooling fan increases if a value obtained by subtracting the first temperature change rate from a value obtained by multiplying the first temperature change rate by the second temperature change rate and the weight K has a positive value.

Claim 4

The method of controlling projector according to Claim 2,

characterized in that, the change rate calculation step calculates a second temperature change rate between the final measurement timepoint and a timepoint immediately before the final measurement timepoint and a first temperature change rate between the final measurement timepoint and a timepoint other than the timepoint immediately before the final measurement timepoint; and

the cooling fan rotation speed determining step determines the rotation speed of the cooling fan such that the rotation speed of the cooling fan is reduced if a value obtained by subtracting the first temperature change rate from a value obtained by multiplying the first temperature change rate by the second temperature change rate and the weight K has a negative value.

Claim 5

The method of controlling projector according to Claim 2,

characterized in that, the change rate calculation step calculates a second temperature change rate between the final measurement timepoint and a timepoint immediately before the final measurement timepoint and a first temperature change rate between the final measurement timepoint and a timepoint other than the timepoint immediately before the final measurement timepoint; and

the cooling fan rotation speed determining step controls the cooling fan so that the cooling fan rotates at a constant speed when a value obtained by multiplying the first temperature change rate by the weight K has the same value as the second temperature change rate.

Claim 6

The method of controlling projector according to any one of Claims 3 to 5,

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wherein the weight K is characterized in that it has a value greater than or equal to 1 and less than or equal to 1.5.

Claim 7

A method of controlling projector comprising: a temperature collection step of measuring the temperature inside the projector housing at regular time intervals and storing the measured temperature in a plurality of memory buffers provided in a projector control unit;

a temperature change prediction step of calculating a first temperature change rate of an initial temperature and a final temperature among the temperatures input to the plurality of memory buffers in the temperature collection step and a second temperature change rate of a recent temperature and a final temperature excluding the final temperature, and predicting a temperature change inside the housing using a prediction variable obtained by subtracting the first temperature change rate from a value obtained by multiplying the second temperature change rate by a weight;

and a cooling fan control step of increasing or decreasing the rotation speed of a cooling fan mounted inside the projector housing according to the prediction variable of the temperature change prediction step.

Claim 8

The method of controlling projector according to Claim 7,

characterized in that, the temperature change prediction step determines that the temperature inside the projector increases and, if the prediction variable has a positive value, the rate of increase in the temperature inside the projector increases; and the cooling fan control step controls the cooling fan so that the rotation speed of the cooling fan increases.

Claim 9

The method of controlling projector according to Claim 7,

characterized in that, the temperature change prediction step determines that the temperature inside the projector decreases and, if the prediction variable has a negative value, the rate of decrease in the temperature inside the projector increases; and the cooling fan control step controls the cooling fan so that the rotation speed of the cooling fan decreases.

Claim 10

The method of controlling projector according to Claim 7,

characterized in that, at least three memory buffers are provided, and the weight has a value greater than or equal to 1 and less than or equal to 1.5.

Claim 11

The method of controlling projector according to Claim 7,

characterized in that, when the prediction variable is 0, the cooling fan control step maintains the rotation speed of the cooling fan.

Claim 12

The method of controlling projector according to Claim 7,

characterized in that, if the temperature stored in the temperature collection step is a temperature higher than a predetermined first temperature, the temperature change prediction step is not performed; and the cooling fan control step rotates the cooling fan at maximum speed.

Claim 13

The method of controlling projector according to Claim 12,

characterized in that, if the temperature stored in the temperature collection step is higher than a predetermined second temperature that is higher than the first temperature, the temperature change prediction step and the cooling fan control step are not performed, and the operation of the projector is terminated.

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Claim 14

The method of controlling projector according to Claim 7,

characterized in that, the temperature collecting step is repeatedly performed while the projector is operating.

Specification

Detailed Description of the Invention

Technical Field

[0001] The present invention relates to a projector having effective cooling performance and a method of controlling the projector. More specifically, the present invention relates to a projector and a method for controlling the projector, which can effectively control the rotation speed of a fan by predicting temperature changes inside the projector.

Prior Art

[0002] A projector is a device that converts an externally supplied image signal into projection light and enlarges and projects the image onto a screen. The projection light projected on the screen will project the light provided by the light source, such as a lamp, provided inside the projector, along with the image.

[0003] The lamp used as the light source is mounted inside the projector housing and generates a large amount of heat. In addition to the lamp, the substrates equipped with various circuit components and the composite-based components that convert the image signals to images and synthesize them to light supplied by the lamp also have a significant amount of heat generation.

[0004] Thus, the projector is provided with a cooling fan, temperature sensor, etc., inside it, and the speed of the cooling fan increases or decreases depending on the temperature inside the projector to cool it down.

[0005] However, conventional general cooling methods change the rotation speed of the cooling fan accordingly, based on the elevated temperature information, when the temperature inside the projector rises above a certain temperature. For example, a method is used in a manner that if the temperature inside the projector increases, the rotation speed of the cooling fan provided inside the projector increases, and if the temperature inside the projector decreases, the rotation speed of the cooling fan decreases.

[0006] However, such method measures the temperature inside the projector in real time and controls the temperature inside the projector based on the measured temperature information. If the temperature inside the projector is high, the cooling fan will always rotate at a rotation speed corresponding to that temperature, and if the temperature inside the projector is low, the cooling fan will rotate at a rotation speed corresponding to that temperature.

[0007] This conventional method has the following problems.

[0008] First, regardless of whether the temperature inside the projector is trending down or upward, the cooling fan will rotate at the rotation speed which corresponds to the temperature inside the projector as is. In other words, the cooling fan rotates at a certain speed without detecting whether the temperature is trending down or up even if the measured temperature is high.

[0009] However, if the temperature inside the projector is in an upward trend, the temperature inside the projector should be reduced by increasing the rotation speed of the cooling fan to protect the parts inside the projector, but if the temperature inside the projector is in a downward trend from the high temperature, the rotation speed of the cooling fan does not need to be increased sharply.

[0010] Furthermore, as the aforementioned conventional general method determines the rotation speed of the cooling fan in response to the real-time temperature of the projector, there is a disadvantage that it cannot respond quickly to temperature changes within the projector.

[0011] In other words, if the process of measuring the temperature inside the projector and determining the rotation speed of the cooling fan in response to the measured temperature is repeated, it cannot quickly respond to the actual temperature change speed, and as the temperature change inside the projector is followed by the change in rotation speed of the cooling fan, the range of temperature rise and fall increases, and the range of corresponding changes in rotation speed of the cooling fan increases accordingly. When the range of change in rotation speed of the cooling fan increases, the noise generated by the cooling fan increases.

Details of the Invention

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Problem to be solved

[0012] The present invention aims to solve the problem by providing a projector and a method of controlling projector which can predict the temperature change inside the projector in advance, thereby effectively reducing the temperature inside the projector, and minimizing the noise generated by the cooling fan provided inside the projector.

Means for solving the problem

[0013] To solve the above challenge, the present invention provides a projector control method comprising: a temperature measuring step wherein the temperature inside a projector housing is measured at predetermined time intervals; a temperature change rate calculation step wherein the change rate of temperatures measured in the temperature measuring step is calculated; a cooling fan rotation speed determining step wherein a rotation speed of a cooling fan mounted inside the projector housing is determined by using the temperature change rate calculated in temperature change rate calculation step; and a cooling fan control step wherein the cooling fan is rotated at the rotation speed of the cooling fan determined in the cooling fan rotation speed determining step.

[0014] In such case, the temperature measuring step measures at least *n* timepoints of the temperatures; the change rate calculation step calculates each temperature change rate between the final measurement timepoint and at least two timepoints among the remaining timepoints excluding the final measurement timepoint; and the cooling fan rotation speed determining step compares each change rates and determines the rotation speed of the cooling fan.

[0015] In addition, the change rate calculation step can calculate a second temperature change rate between the final measurement timepoint and a timepoint immediately before the final measurement timepoint and a first temperature change rate between the final measurement timepoint and a timepoint other than the timepoint immediately before the final measurement timepoint, and the cooling fan rotation speed determination step determines the rotation speed of the cooling fan such that the rotation speed of the cooling fan increases if a value obtained by subtracting the first temperature change rate from a value obtained by multiplying the first temperature change rate by the second temperature change rate and the weight K has a positive value.

[0016] Furthermore, the change rate calculation step can calculate a second temperature change rate between the final measurement timepoint and a timepoint immediately before the final measurement timepoint and a first temperature change rate between the final measurement timepoint and a timepoint other than the timepoint immediately before the final measurement timepoint, and the cooling fan rotation speed determination step determines the rotation speed of the cooling fan such that the rotation speed of the cooling fan decreases if a value obtained by subtracting the first temperature change rate (L) from a value obtained by multiplying the first temperature change rate by the second temperature change rate and the weight K has a negative value.

[0017] Herein, the change rate calculation step calculates a second temperature change rate between the final measurement timepoint and a timepoint immediately before the final measurement timepoint and a first temperature change rate between the final measurement timepoint and a timepoint other than the timepoint immediately before the final measurement timepoint, and the cooling fan rotation speed determining step can control the cooling fan to rotate at a constant speed when a value obtained by multiplying the first temperature change rate and the weight K has a value equal to the second temperature change rate (P).

[0018] In addition, the weight K may have a value greater than or equal to 1 and less than or equal to 1.5.

[0019] In addition, in order to solve the above problem, the present invention provides a projector control method comprising: a temperature collection step of measuring the temperature inside the projector housing at regular time intervals and storing the measured temperatures in a plurality of memory buffers provided in a projector control unit; a temperature change prediction step of calculating a first temperature change rate of an initial temperature and a final temperature among the temperatures input to the plurality of memory buffers in the temperature collection step and a second temperature change rate of a recent temperature excluding a final temperature and the final temperature, and predicting a temperature change inside the housing using a prediction variable obtained by subtracting the first temperature change rate from a value obtained by multiplying the second temperature change rate by a weight; and a cooling fan control step of increasing or decreasing the rotation speed of a cooling fan mounted inside the projector housing according to the prediction variable of the temperature change prediction step.

[0020] Furthermore, the temperature change prediction step can determine that, when the temperature inside the projector increases and the prediction variable (A) has a positive value, the rate of increase in the temperature inside the projector increases, and the cooling fan control step controls the cooling fan so that the rotation speed of the cooling fan increases.

[0021] Herein, the temperature change prediction step determines that, when the temperature inside the projector decreases and the prediction variable has a negative value, the rate of decrease in the temperature within the projector decreases, and the cooling fan control step can control the cooling fan so that the rotation speed of the cooling fan decreases.

[0022] In addition, the memory buffer is provided with at least three or more, and the weight may have a value greater than or equal to 1 and less than or equal to 1.5.

[0023] In such case, if the prediction variable is 0, the cooling fan control step can maintain the rotation speed of the cooling fan.

[0024] In addition, if the temperature stored in the temperature collection step is at or above a predetermined first temperature, the temperature change prediction step is not performed, and the cooling fan control step can rotate the cooling fan at a maximum speed.

[0025] In addition, if the temperature stored in the temperature collection step is higher than a predetermined second temperature which is higher than the first temperature, the temperature change prediction step and the cooling fan control step are not performed, and operation of the projector can be terminated.

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[0026] Herein, the temperature collection step can be performed repeatedly while the projector is operating.

Effect

[0027] According to the projector and the method of controlling the projector in the present invention, the temperature change inside the projector can be predicted in advance, thereby effectively controlling the temperature inside the projector.

[0028] In addition, according to the other aspect of the projector and the controlling method of the projector in the present invention, the noise generated by the cooling fan provided inside the projector can be minimized.

Specific details for implementing the invention

[0029] Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the attached drawings. However, the invention may be embodied in other forms, not limited to the embodiments described herein. Rather, the embodiments introduced herein are provided so that the disclosed contents can be thorough and complete, and so that the idea of the invention can be sufficiently communicated to those skilled in the art. Throughout the specification, the same reference numerals represent the same components.

[0030] FIG. 1 is a schematic illustration of a projector according to the present invention. A projector according to the present invention includes a housing (110) forming an outer shape; wherein an optical engine (120) that converts an input image signal into projection light and projects it; at least one temperature sensor (130) mounted inside the housing (110); a cooling fan (140) mounted inside the housing (110); and a control unit (150) that controls the cooling fan (140) using the temperature measured by the temperature sensor (130) and has a plurality of memory buffers (151) capable of storing the temperature measured by the temperature sensor (130).

[0031] The housing (110) forms the appearance of a projector and may form a plurality of vents (not shown) including an air inlet and an air outlet.

[0032] The housing (110) is provided with an optical engine (120) including a lamp as a light source. The optical engine (120) uses the light supplied from the lamp to convert the externally supplied image signal into projection light.

[0033] The optical engine (120) includes components that generate a lot of heat, including the lamp. Thus, the cooling fan (140) is provided to effectively cool the heat generated inside the housing (110).

[0034] The cooling fan (140) is rotated at a rotation speed according to the temperature measured by the temperature sensor (130) provided inside the housing (110). The cooling fan (140) is controlled by a control unit (150) that controls the optical engine (120) and the cooling fan (140).

[0035] In addition, the control unit (150) of the projector according to the invention is characterized by a plurality of memory buffers (151) that can store the temperature measured in the temperature sensor (130).

[0036] The temperature measured in the temperature sensor (130) may be stored and updated sequentially in the memory buffer (151).

[0037] That is, the temperature is measured in the temperature sensor (130) at predetermined time intervals and the measured temperature is stored sequentially in the memory buffer (151). And, when the temperatures are stored in all memory buffers (151), the previously stored temperatures are deleted and new temperatures are continuously stored.

[0038] In the embodiment illustrated in FIG. 1, the memory buffers (151) are illustrated as being provided with *n* in the control unit (150), and if stored in the direction of the *n*th buffer from the 1st memory buffer (151), the memory buffer (151) in which the temperature is stored first is updated with the subsequently stored temperature, and the last *n*th memory buffer (151) can be set to store a new temperature.

[0039] By providing a plurality of memory buffers (151) in the control unit (150) to store the temperature inside the projector housing (110) at predetermined time intervals, the temperature within the projector housing (110) can be predicted and the rotation speed of the cooling fan (140) can be controlled by the method described below.

[0040] The memory buffer (151) is intended to calculate and compare the rate of temperature change in at least two or more intervals as described below, and the control unit (150) preferably uses the temperature stored in the memory buffer (151) to compare the rate of temperature change in at least two intervals to determine the rotation speed of the cooling fan (140). In other words, the temperature inside the projector is predicted based on the calculated temperature change rate by calculating the temperature change rate of at least two or more using the temperature stored in the memory buffer (151).

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[0041] In addition, two temperature information measured at different times is required to calculate one temperature change rate, and the temperature must be measured at more than 3 points in order to compare two or more temperature change rates, it is desirable that the number of the memory buffers (151) be three or more.

[0042] Hereinafter, we will review the method of controlling the rotation speed of the cooling fan (140) using the temperature stored in the memory buffer (151) in particular.

[0043] FIG. 2 is a block diagram of a method of controlling projector according to the present invention. As shown in FIG. 2, the method of controlling a projector according to the present invention includes a temperature measuring step (S100) measuring a temperature inside the projector housing (110) at predetermined time intervals; a temperature change rate calculation step (S200) calculating a rate of change in the temperature measured in the temperature measuring step; a cooling fan (140) rotation speed determining step (S300) that determines the rotation speed of the cooling fan (140) mounted inside the projector housing (110) using the temperature change rate calculated in the temperature change rate calculation step (200); and a cooling fan control step (S400) rotating the cooling fan (140) at a rotation speed of a cooling fan determined in the cooling fan rotation speed determining step (S300).

[0044] The temperature measuring step (S100) is based on a method of measuring the temperature within the projector housing (110) at predetermined time intervals by a temperature sensor (130) provided within the projector.

[0045] The temperature measuring step (S100) may be set to repeat at predetermined time intervals or periodically if the projector is operating. This temperature measuring step (S100) may comprise a temperature collection step for collecting the temperature inside the projector, including a step of storing the temperature in the memory buffer.

[0046] In addition, the change rate calculation step (S200) and the cooling fan rotation speed determining step (S300) constitute the temperature change prediction step that predicts the temperature change inside the housing (110).

[0047] Here, the temperature measuring step (S100) can measure the temperature at at least *n* timepoints. By measuring the temperature at *n* timepoints, it is meant that the temperature is measured at predetermined time intervals and stored in the memory buffer (151). That is, the temperature may be measured and stored at predetermined time intervals.

[0048] Herein, a predetermined time interval may be set to be periodic, or a time interval corresponding to each temperature range may be set separately.

[0049] And the temperature stored in the memory buffer (151) is sequentially updated, and a new temperature may be stored.

[0050] After the temperature measurement step (S100), the change rate calculation step (S200) is performed by using the temperature measured in the temperature measurement step (S100) to calculate the rate of change in temperature of each of the n timepoints and at least 2 timepoints of the remaining timepoints excluding the final measurement timepoint.

[0051] The change rate calculation step (S200), which calculates each temperature change rate from at least two timepoints between the final measurement timepoint and the remaining timepoint excluding the final measurement timepoint among the *n* timepoints, is ultimately performed to calculate the rate of change in the temperature in a narrow range and a wide range including the narrow range, and then compare the two rate of change.

[0052] In other words, its purpose is to predict the future temperature changes by comparing the overall temperature changes with the recent temperature changes.

[0053] FIG. 3 is a graph illustrating the change rate calculation step. The number (n) of memory buffers (151) aforementioned is assumed to be four. As shown in FIG. 2, the temperature sensor (130) measures the temperatures (T1 to T4) at a plurality of measurement timepoints (t1 to t4).

[0054] As can be determined from the time-temperature graph shown in FIG. 3, the temperature inside the projector shows a progressively increasing state.

[0055] The temperature change rate calculation step performed after the temperature measurement step of the method of controlling projector according to the present invention can calculate the rate of change in temperature of each timepoint between the final measurement timepoint (t4) and at least two of the remaining timepoints (t1 to t3) except for the final measurement timepoint (t4).

[0056] In the graph shown in FIG. 3, the temperature measured at the final measurement point t4 is T4. And the remaining measurement timepoints, except for the final measurement timepoint (t4), may be at least two of the measurement timepoints (t1 to t3), for example, t1 and t3.

[0057] In the end, the change rate calculation step may be a step that calculates the rate of change in temperature between the final measurement timepoint (t4) and the measurement timepoint (t1 and t3), respectively. The temperature change rate between the final measurement timepoint (t4) and the measurement timepoint (t1) is to determine the overall temperature change rate, and the final measurement timepoint (t4) and the measurement timepoint (t3) are to calculate the temperature change rate to measure the recent temperature change.

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[0058] If there are many measurement timepoints, the initial and final timepoints for calculating the rate of change can be selected, and the temperature change rate can be calculated and compared in relation to the final timepoint by selecting one of the timepoints that exists between them. Thus, the selection of the measurement timepoint can be varied if information can be provided to compare the temperature change rate.

[0059] The rate of change in temperature between any two timepoints of t1 at the measurement timepoint, t3 at the measurement timepoint, and t4 at the measurement timepoint can be determined by the slope of the graph shown in FIG. 3. In other words, the temperature change rate of the measurement timepoint t3 and the measurement timepoint t4 can be calculated as {T4-T3}/{t4-t3}. In addition, the rate of change in temperature of the measurement timepoint t1 and the measurement timepoint t4 can be calculated as {T4-T1}/{t4-t1}.

[0060] The method of controlling the projector according to the present invention is an invention that proactively calculates the rotation speed of the cooling fan (140) by predicting the change in temperature, thereby reducing the width of the temperature change inside the projector, and thus intending a noise reduction effect.

[0061] Therefore, it is necessary to compare the rate of change of temperature (hereinafter referred to as the “first temperature change rate (L)”) that can determine the trend of overall temperature change inside the projector with the rate of change of temperature (hereinafter referred to as the “second temperature change rate (P)”) that can determine the trend of recent temperature change inside the projector.

[0062] The meaning that the first temperature change rate (L) has a positive value means that the temperature increases overall, and the meaning that the second temperature change rate (P) has a positive value means that the recent temperature increases.

[0063] Once again described using FIG. 3, the second temperature change rate (P) may be calculated as {T4-T3}/{t4-t3} and the first temperature change rate (L) may be calculated as {T4-T1}/{t4-t1}.

[0064] The method of controlling the projector according to the present invention can use a method of calculating the rate of change of temperature of multiple units in multiple sections to proactively calculate the rotation speed of the cooling fan (140) by predicting the change of temperature.

[0065] In the graph shown in FIG. 3, the temperature inside the projector gradually rises with a constant slope. Therefore, the second temperature change rate (P) and the first temperature change rate (L) have approximately the same values.

[0066] In addition, the cooling fan (140) rotation speed determining step that constitutes the method of controlling the projector according to the present invention can determine the rotation speed of the cooling fan (140) by comparing the respective rate of change, and the specific method can be used to determine the rotation speed of the cooling fan (140) so that the rotation speed of the cooling fan (140) is increased If the value obtained by subtracting the first temperature change rate (L) from the product of the first temperature change rate (L) and the second temperature change rate (P) and the weight K has a positive value.

[0067] The weight K is a variable added to focus on the second temperature change rate (P), which is the rate of change of temperature that can determine the trend of recent temperature change inside the projector, and the second temperature change rate (P), which is the rate of change of temperature that can determine the trend of overall temperature change inside the projector.

[0068] As shown in the graph shown in FIG. 3, even if the temperature change rate inside the projector over time is constant, the temperature inside the projector is increasing, so the rotation speed of the cooling fan (140) is preferably to be increased.

[0069] Therefore, to predict the temperature inside the projector due to the difference in the temperature change rate, it may be easy to determine by focusing on the recent temperature change rate.

[0070] For example, in FIG. 3, if the weight K is set to 1.3, and the first temperature change rate (L) is 1, the threshold of the second temperature change rate (P) to increase the rotation speed of the cooling fan (140) is about 0.77, which is a value that satisfies the second temperature change rate (P)*1.3–1=0.

[0071] Therefore, if the value obtained by subtracting the first temperature change rate (L) from the product of the first temperature change rate (L) and the second temperature change rate (P) and the weight K has a positive value, the rotation speed determining step determines to increase the rotation speed of the cooling fan (140). If the change rate of the second temperature change rate (P), i.e., the slope, has a value of 0.77 or more, the temperature change rate itself will decrease, but the rotation speed of the cooling fan (140) will increase.

[0072] In addition, if the first temperature change rate (L) has a negative value, that is, if the temperature inside the projector is in a decreasing trend, the step of determining the rotation speed of the cooling fan (140) can determine the rotation speed of the cooling fan (140) so that the rotation speed of the cooling fan (140) is reduced if the value obtained by subtracting the first temperature change rate (L) from the product of the second temperature change rate (P) and the weight K has a negative value.

[0073] Likewise, if the weight K is set to 1.3, and the first temperature change rate (L) is –1, the threshold of the second temperature change rate (P) to reduce the rotation speed of the cooling fan (140) is about –0.77, which is a value that satisfies the second temperature change rate (P)*1.3–(–1)=0.

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[0074] Therefore, it can be determined to reduce the rotation speed of the cooling fan (140) if the value obtained by subtracting the first temperature change rate (L) from the product of the first temperature change rate (L) and the second temperature change rate (P) and the weight K has a negative value.

[0075] That is, if the slope has a steeper rate of change in temperature than –0.77, the temperature inside the projector is rapidly decreasing, so the rotation speed of the cooling fan (140) can be set to decrease. In other words, if the slope has a rate of change in temperature less than –0.77, the rotation speed of the cooling fan (140) can be set to be maintained without being reduced.

[0076] FIG. 4 is a block diagram detailing the temperature change prediction step consisting of the temperature change rate calculation step (S200) and the cooling fan rotation speed determining step (S300) from the method of controlling the projector according to the present invention.

[0077] The method of determining the rotation speed of the cooling fan (140) by using the multiple rates of change calculated in the change rate calculation step (S200) requires a process to determine whether the first rate of change (L), which is the rate of change in temperature that can determine the overall temperature change, is greater than or less than 0.

[0078] The first temperature change rate (L) can be used to determine whether the temperature inside the projector has risen or fallen overall.

[0079] If the first temperature change rate (L) has a positive value, it can be determined that the temperature inside the projector generally rises. And since the temperature inside the projector is rising, the rotation speed of the cooling fan (140) must be maintained or increased.

[0080] If the rise of the temperature inside the projector is small and the current rotation speed of the cooling fan (140) can sufficiently cool down the temperature inside the projector, then there is no need to increase the rotation speed of the cooling fan (140).

[0081] If the first rate of temperature change (L) in FIG. 4 has a positive value, the weight K aforementioned can be used to determine (S320-1) whether to increase or maintain the rotation speed of the cooling fan (140).

[0082] In other words, if the rate of change of the temperature inside the projector, i.e., the value obtained by subtracting the first temperature change rate (L) from the product of the second temperature change rate (P) and the weight K inside the projector has a positive value (a value used to predict temperature change in the temperature change prediction step, hereinafter referred to as the prediction variable "A"), the rotation speed of the cooling fan (140) can be determined (S330) so that the rotation speed of the cooling fan (140) is increased.

[0083] If the first temperature change rate (L) reflecting the overall temperature change trend has a positive value, i.e., in an atmosphere where the temperature inside the projector is rising (the first temperature change rate (L) > 0), the prediction variable (A) obtained by subtracting the first temperature change rate (L) from the product obtained by multiplying the second temperature change rate (P), which is the recent temperature change rate, by the weighted value, has a positive value, the temperature rising trend becomes more severe and needs to change the rotation speed of the cooling fan (140) faster, so the cooling fan (140) rotation speed determining step can determine (S330-1) to increase the rotation speed of the cooling fan (140). Thus, when the prediction variable (A) is 0, the rotation speed of the projector cooling fan may be maintained.

[0084] The weight K is a characteristic value of the projector and can therefore be determined experimentally. The weight K can be used with a value between 1 and 1.5. That is, the value that can be determined including the correlation of the cooling performance of the projector and the cooling fan (140).

[0085] If the recent rate of temperature change has a greater effect on determining the overall rate of temperature change, the K value can be used with a large value, and in the opposite case, a small value can be used.

[0086] When reviewed again using FIG. 4, in an atmosphere where the temperature inside the projector is rising (the first temperature change rate (L) > 0), if the prediction variable (A) obtained by subtracting the first temperature change rate (L) from the value obtained by multiplying the second temperature change rate (P) by the weight (K) has a negative value, the temperature inside the projector is rising, but the rising trend does not need to increase the rotation speed of the cooling fan (140). Thus, in this case, the rotation speed of the cooling fan (140) can be maintained (S330-3).

[0087] Conversely, if the first temperature change rate (L) reflecting the overall temperature change trend has a negative value, i.e., in an atmosphere where the temperature inside the projector is decreasing (the first temperature change rate (L) < 0), the prediction variable (A) obtained by subtracting the first temperature change rate (L) from the value obtained by multiplying the second temperature change rate (P) by the weight (K) has a negative value, which means that the temperature decreasing trend is accelerating further and the rotation speed of the cooling fan (140) needs to be reduced. Therefore, the cooling fan (140) rotation speed determination step can determine (S330-2) that the rotation speed of the cooling fan (140) is reduced.

[0088] In addition, in an atmosphere where the temperature inside the projector is decreasing (the first temperature change rate (L) < 0), the predicted variable (A)r, which is the value obtained by multiplying the second temperature change rate (P) by the weight (K) minus the first temperature change rate (L), has a positive value, it means that the temperature inside the projector decreases, but the downward trend is not so great that it is unnecessary to reduce the rotation speed of the cooling fan (140). Thus, in this case, the rotation speed of the cooling fan (140) can be maintained.

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[0089] FIG. 5 shows an example of controlling the rotation speed of the cooling fan (140) according to the method of controlling the projector in the present invention when the number of memory buffers (151) provided in the projector control unit (150) is 4 and the weight (K) is 1.2.

[0090] The threshold rate of change that determines whether the rotation speed of the cooling fan is increased (or decreased) and whether it is maintained may vary depending on the value of the weight (K). Therefore, the rotation speed of the cooling fan is determined by considering the approximate trend of temperature change without considering its specific temperature value.

[0091] (a) is a case where the rotation speed of the cooling fan (140) is increased, (b) is a case where the temperature inside the projector increases overall but the rotation speed of the cooling fan (140) is maintained, and a case of (c) is also the same as (b).

[0092] In cases of (d) and (e), the temperature decrease is occurring at a sufficient rate with reference to the overall first temperature change rate (L) and second temperature change rate (P) inside the projector, so it can be determined that the speed of the cooling fan (140) can be reduced. In case of (f), the rotation speed of the cooling fan (140) is maintained without being reduced because the recent temperature decrease is insufficient.

[0093] FIG. 6 shows a temperature change within a projector according to the present invention.

[0094] When the projector is operated, the internal temperature rises, and in a normal operating range *a* below a predetermined first temperature (T1), as described above, the cooling fan is controlled by the above-mentioned method of measuring the temperature, calculating the rate of change, determining the cooling fan (140) rotation speed, and controlling the cooling fan (140), as described above.

[0095] In this normal range, the cooling fan is controlled so that the temperature inside the projector is maintained near the target temperature (Tf). In this case, the control method of the projector according to the present invention can reduce the amplitude of the temperature change based on the target temperature (Tf).

[0096] However, this method only means that at least the temperature inside the projector does not interfere with normal operation of the projector but is within a range where the temperature inside the projector can be lowered in terms of component protection.

[0097] However, if the temperature inside the projector is outside the normal range (T1 or higher, Segment b), it is necessary to ignore the above measurement and judgment steps and rotate the cooling fan at the highest speed for the temperature inside the projector. The pre-determined temperature T1 does not have to stop the projector from working, but it is the temperature when the temperature inside the projector need to be lowered immediately.

[0098] In addition, there may be cases where the temperature inside the projector reaches a critical point where normal operation of the projector is impossible and damage to components is so severe that the projector must be shut down immediately. This is when the cooling fan (140) does not operate normally, or when it operates but the temperature inside the projector rises above the second temperature, which is higher than the predetermined first temperature, for an abnormal reason.

[0099] It means that there may be problems such as damage to internal parts of the projector or a risk of fire, if the projector continues to run at a predetermined second temperature.

[0100] Therefore, when the temperature inside the projector rises at or above T2, which is higher than the predetermined temperature T1, the projector can be controlled so that all operation of the projector stops (Segment c).

[0101] While this specification has been described with reference to preferred embodiments of the invention, those skilled in the art will be able to make various modifications and variations to the invention to the extent that they do not deviate from the idea and area of the invention set forth in the claims described below. Therefore, if the modified implementation basically includes components of the claims of the present invention, it should be considered to be included in the technical scope of the present invention.

Brief description of the drawing

[0102] FIG. 1 is a schematic illustration of a projector according to the present invention.

[0103] FIG. 2 is a block diagram of a method of controlling projector according to the present invention.

[0104] FIG. 3 is a graph illustrating the change rate calculation step.

[0105] FIG. 4 is a block diagram detailing the cooling fan rotation speed determining step among the projector control methods according to the present invention.

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[0106] FIG. 5 shows an example of controlling the rotation speed of a cooling fan, according to the method of controlling the projector according to the present invention, when the number of memory buffers provided in the projector controller is 4 and the weight (K) is 1.2.

[0107] FIG. 6 shows a temperature change within a projector according to the present invention.

[0108] ** Description of references for main part of drawings **

[0109] 100 : Projector 110 : Housing

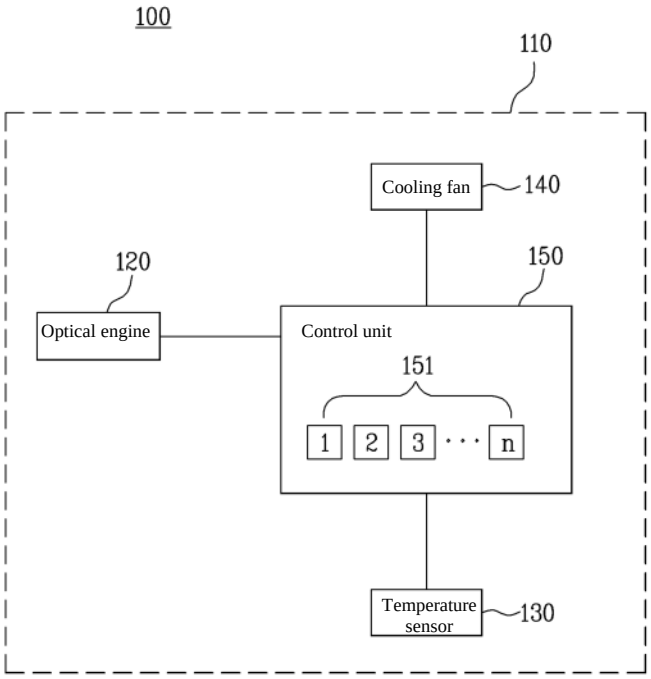
[0110] 120 : Optical engine 130 : Temperature sensor

[0111] 140 : Cooling fan 150 : Control unit

[0112] 151 : Memory buffer

Drawings

FIG. 1



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FIG. 2

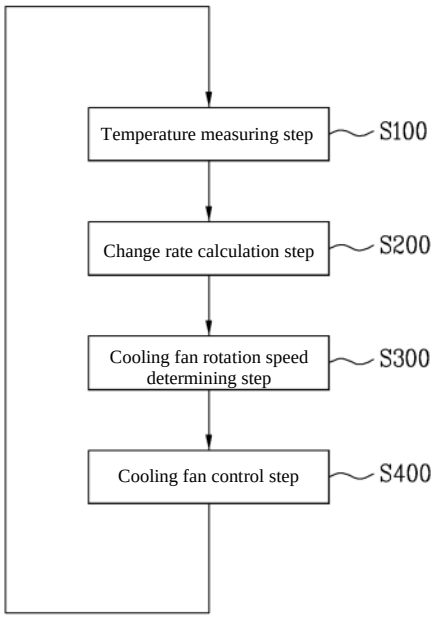

Temperature measuring step
S100
Change rate calculation step
S200
Cooling fan rotation speed determining step
S300
Cooling fan control step
S400

FIG. 3

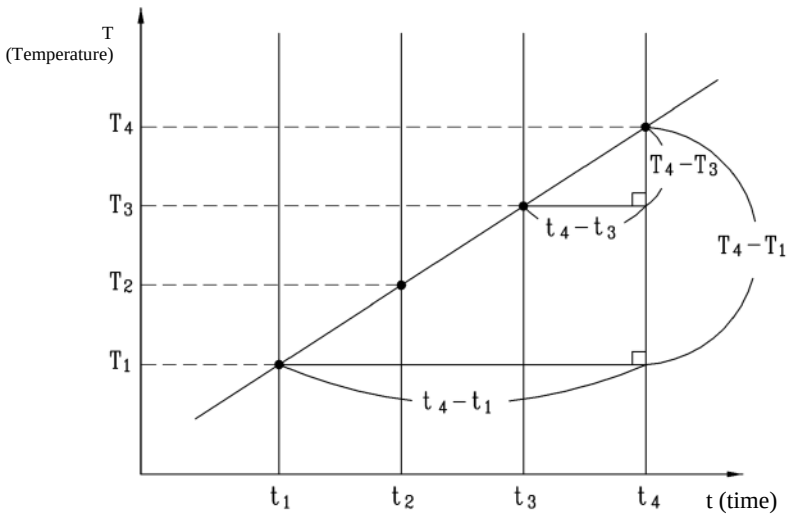
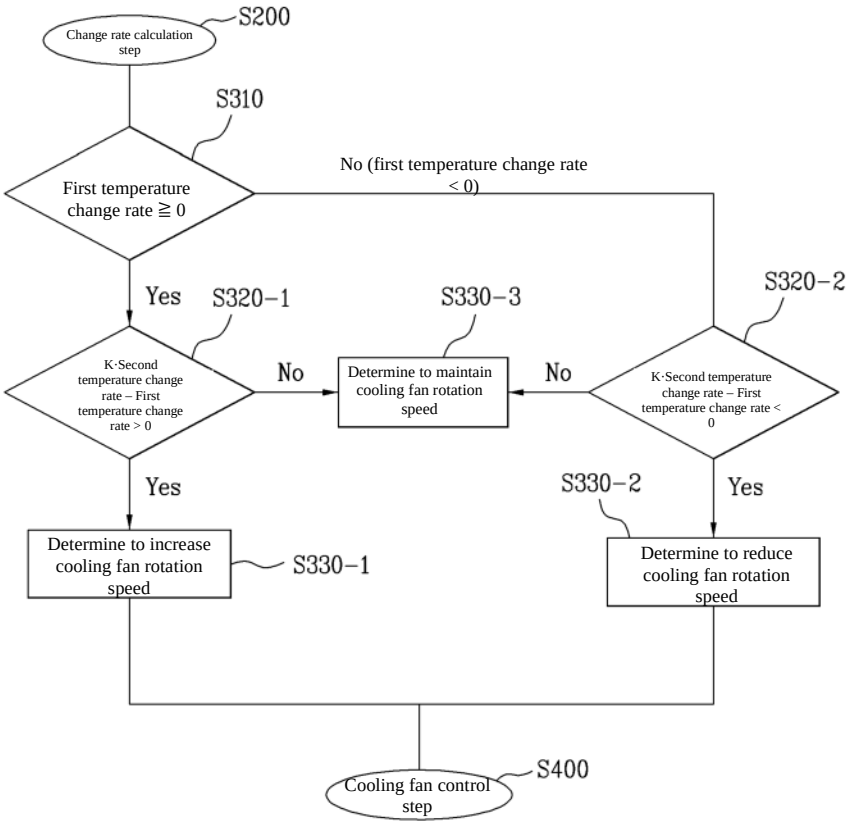
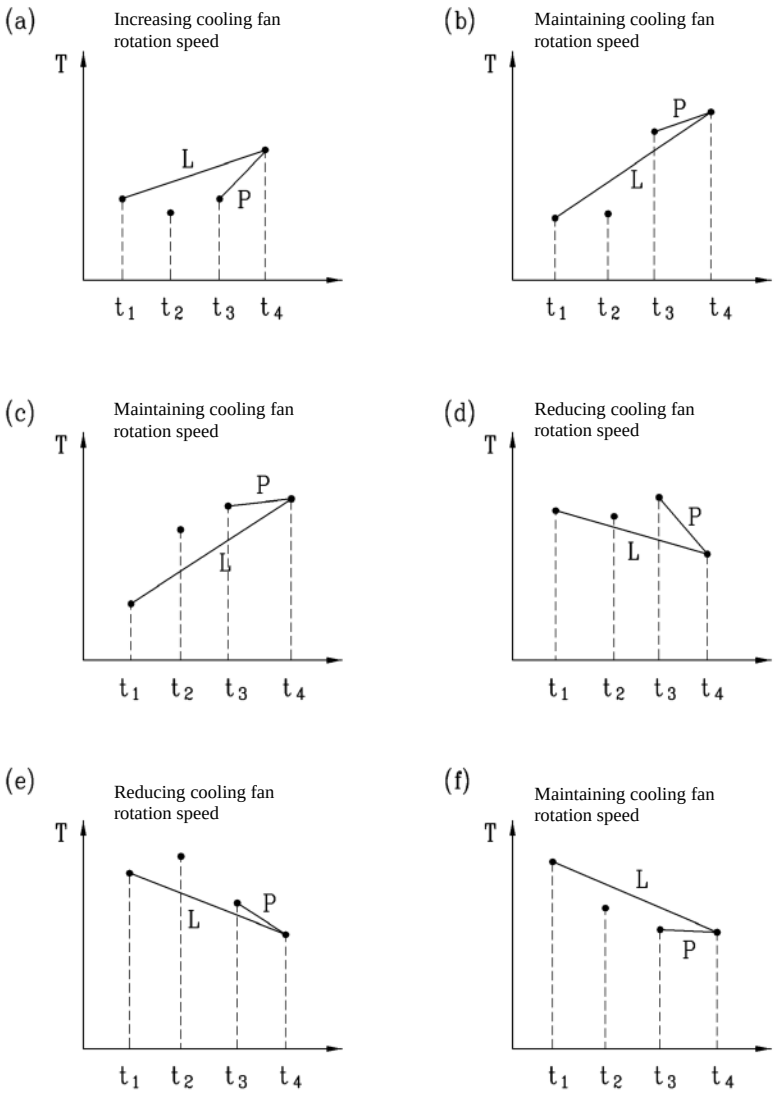

T
(Temperature)
T4
T3
T2
T1
t1
t2
t3
t4
t (time)
T4 − T3
t4 − t3
T4 − T1
t4 − t1

FIG. 4



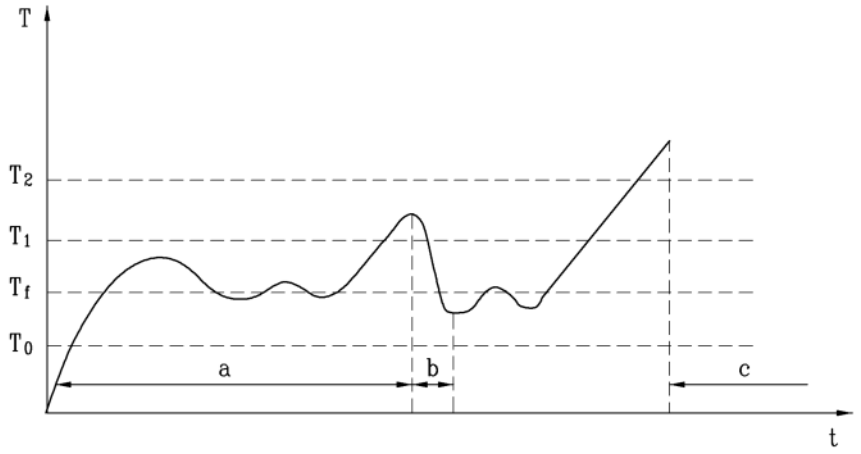
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FIG. 5



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FIG. 6



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