Description

APPARATUS AND METHOD FOR AUTOMATICALLY MONITORING FIXED HEAT SOURCES IN HOME KITCHEN

Technical Field

The present invention relates to the field of heat source monitoring and alerting, and in particular to an apparatus and method for automatically monitoring heat sources in a home kitchen.

Background Art

With the accelerating pace of the aging of population in China, there are increasing potential safety hazards due to the incorrect use of fixed heat sources (a gas stove fire, an induction cooker, an electric frying pan, etc.) by the elderly people in kitchens. Due to the memory deterioration with age, the elderly people often forget to turn off the fire (or a kitchen appliance switch), which causes the food in the pot to be heated on the kitchen stove for a long time, resulting in overcooked food, and also causes the induction cookers, electric frying pans and pots to break down occasionally. Especially the unattended burning of gas stove fire for a long time may also bring about dangers, such as fire, on life and property safety. In the prior art, there is no apparatus specifically for monitoring and alerting fixed heat sources in a kitchen. To this end, the research direction of those skilled in the art is to provide an apparatus for intelligent home control when a fixed heat source or no fixed heat source is present in the case of automatically recognizing that there is a person in a kitchen and that there is no person in a kitchen, thereby effectively avoiding fire accidents in the kitchen and life and property safety hazards, and improving the safety and quality of life.

Summary of the Invention

The main purpose of the present invention is to overcome the defects and deficiencies of the prior art, and to provide an apparatus and method for

automatically monitoring heat sources in a home kitchen, having two states, i.e. human body monitoring and heat source scanning, which can solve the problem that the existing infrared monitoring apparatus cannot automatically recognize a static human body and fixed heat sources, and thus can effectively monitor the fixed heat sources in the kitchen, achieving the safe and intelligent home control of a kitchen.

In order to achieve the above purpose, the present invention uses the following technical solution:

an apparatus for automatically monitoring heat sources in a home kitchen of the present invention, comprising a controller, and a stepper motor control circuit, an infrared detector, a stepper motor 0° position recognition circuit, status indicator lights, buttons and a voice circuit, which are connected to the controller, wherein the stepper motor control circuit is connected to a stepper motor; the infrared detector is configured to monitor a moving human body and detect the amount of infrared radiation from all fixed heat sources in the kitchen, and comprises a driving circuit, a dual-element pyroelectric infrared sensor, a filter amplifier, a gate screen execution mechanism and a Fresnel lens, the filter amplifier being connected to the controller, the dual-element pyroelectric infrared sensor being connected to the filter amplifier, the Fresnel lens being arranged at a front end of the dual-element pyroelectric infrared sensor, the driving circuit being connected to the controller, and the gate screen execution mechanism being connected to the driving circuit; the driving circuit is configured, under the control of the controller, to generate forward and reverse direct current flowing through a direct-current electromagnet; the gate screen execution mechanism is configured, under the drive of the driving circuit, to achieve automatic switching between two states, i.e. human body monitoring and heat source scanning; the dual-element pyroelectric infrared sensor is configured to recognize a moving heat source; and the Fresnel lens is configured such that infrared light rays radiated from a target are focused onto the dual-element pyroelectric infrared sensor located at the focal point of the lens, the dual-element pyroelectric infrared sensor is configured to recognize the moving heat source, and the filter amplifier is configured to filter and amplify weak pulse signals output by the dual-element pyroelectric infrared sensor.

As a preferred technical solution, the Fresnel lens is configured such that the infrared light rays radiated from the target are focused onto the dual-element pyroelectric infrared sensor located at the focal point of the lens by means of concentric circular narrow bands on a mirror surface of the Fresnel lens, a sensing angle is divided into alternate “bright areas” and “dark areas”, and when a human body moves to the sensing angle, the continuous light pulse generated is radiated onto the dual-element pyroelectric infrared sensor.

As a preferred technical solution, the gate screen execution mechanism comprises a direct-current electromagnet, a direct-current electromagnet fixing frame, a permanent magnet, a limiting baffle, a gate screen, a gate screen supporting rod, and three hinges, wherein the three hinges are connected in the form of a coaxial cylindrical stack; the direct-current electromagnet is arranged in the direct-current electromagnet fixing frame; the permanent magnet is fixed to a root of the gate screen supporting rod; a lower portion of the gate screen supporting rod is configured for mounting the gate screen; and the gate screen supporting rod is made of non-ferrous metal, a circular permanent magnet is fixed by the root of the gate screen supporting rod by means of four screw fixing holes, the surface area of the circular permanent magnet is equal to the surface area of the direct-current electromagnet, two further screw fixing holes are configured for a fixed connection between the gate screen supporting rod and the second hinge, and the gate screen mounted under the gate screen supporting rod is made of black paper to reduce the weight of the gate screen.

As a preferred technical solution, the filter amplifier has a model of BIS0001; the stepper motor uses a 28BYJ48 stepper motor driven by a ULN2003 driver; the voice circuit uses an ISD1700 voice chip; and the controller uses an STC15F2K60S2 single-chip microcomputer.

As a preferred technical solution, the controller, the voice circuit, and the stepper motor 0° position recognition circuit are arranged in a housing, and the status indicator lights and the buttons are arranged on a front panel of the housing; and the infrared detector is connected to a stepper motor in the housing via a stepper motor rotating shaft.

As a preferred technical solution, the stepper motor 0° position recognition circuit is composed of an LED light on a center line of the infrared detector, and a photoresistor in a 0° position gap on a center line of a box body; the LED light on the center line of the infrared detector is a 0° position light;

the buttons are arranged at a lower end of the box body; and the status indicators use three LED lights to respectively indicate three operating states, i.e. “heat source scanning”, “human body monitoring” and “system self-checking”.

As a preferred technical solution, further comprising a power supply for supplying power to a monitoring and alerting apparatus, wherein the power supply is implemented by an on-off power module and is configured to generate +5V power supply and +12V power supply; the +5V power supply supplies power to the controller, the stepper motor control circuit, the stepper motor 0° position recognition circuit, the status indicator lights, the voice circuit and the stepper motor, which are located inside the box body; and the +12V power supply supplies power to the infrared detector through an external signal-power wire.

The present invention further provides a monitoring method for the apparatus for automatically monitoring heat sources in a home kitchen, comprising the following steps:

S1, performing power-on initialization, in which when no person enters a kitchen, and fixed heat sources in the kitchen are all deactivated, a power button of the apparatus is pressed, and the system first measures initialization data;

S2, recognizing that a moving human body target enters the kitchen, in which after the power-on initialization, the system proceeds to a human body monitoring state; when a person enters the kitchen, the dual-element pyroelectric infrared sensor receives infrared radiation pulse signals of the moving human body, the infrared radiation pulse signals are filtered, amplified and then transferred to the controller for signal processing, and after determining that there is a moving human body target within a sensing angle, the controller of the apparatus sends a control instruction to the driving circuit in the infrared detector, to drive the direct-current electromagnet to generate a magnetic pole with the different polarity from a permanent magnet on a gate screen supporting rod, such that a second gate screen is

attracted to the position of the direct-current electromagnet fixing frame, i.e. being closed, while a first gate screen remains open, reducing the sensing angle by half; and when the human body target is monitored again, indicating that a human body enters the kitchen, the apparatus does not give an alarm about the heat sources, or otherwise performs a processing as if no human body enters the kitchen, and returns to the human body monitoring state;

S3, recognizing that the moving human body target moves out of the kitchen, in which after determining that the human body enters the kitchen, the controller of the apparatus sends a control instruction to the driving circuit in the infrared detector, and in contrast to the process of the step S2, the first gate screen is attracted to the position of the direct-current electromagnet fixing frame, i.e. being closed, while the second gate screen remains open, reducing the sensing angle by half; and when the human body target is monitored again, indicating that the moving human body moves out of the kitchen, or otherwise performs a processing as if there is a person in the kitchen, and returns to the human body monitoring state;

S4, recognizing whether a fixed heat source is activated when there is no person in the kitchen, including: first, determining whether there is no person in the kitchen in the human body monitoring state, and when it is monitored that there is no person in the kitchen, starting to recognize the activated state of the fixed heat source in the kitchen;

S5, recognizing the degree of danger of the heat source and automatically giving a voice alarm, in which when a stove fire on the fixed heat source within the sensing angle is in a high level, the amount of infrared radiation is large, the collected infrared data is large, and when the value of a_i of N times of continuous detection is beyond a set maximum value, the controller automatically reduces the set playing time period of the voice circuit, and when the set playing time is reached, the controller controls the voice circuit to give, by means of a speaker, an alarm “Your kitchen’s stove fire is on and in a high level, and you have left the kitchen for XX minutes, please watch out for the stove fire”; when the stove fire is in a low level, the amount of infrared radiation is small, the collected infrared data is small,

and when the value of a_i of N times of continuous detection is beyond a set minimum value, the controller automatically extends the set playing time period of the voice circuit, and when the set playing time is reached, the controller controls the voice circuit to give, by means of the speaker, an alarm "Your kitchen's stove fire is on and in a low level, and you have left the kitchen for XX minutes, please watch out for the stove fire"; and when the stove fire is in a medium level, the amount of infrared radiation is medium, the collected infrared data is at an intermediate value, and when the value of a_i of N times of continuous detection is beyond a set intermediate value, the controller automatically set the set playing time period of the voice circuit to be moderate, and when the set playing time is reached, the controller controls the voice circuit to give, by means of the speaker, an alarm "Your kitchen's stove fire is on and in a medium level, and you have left the kitchen for XX minutes, please watch out for the stove fire";

S6, recollecting and updating the initialization data, in which when it is determined in step S4 that there is no person in the kitchen and no any fixed heat source is activated, since the current environment has uncertainties including the sunlight infrared radiation, the temperature difference between day and night, and the opening and closing of a kitchen window, the initial comparison value will change and need to be re-measured with the same method as in step S1, and the original values are overwritten with the re-measured initial comparison value V_n in the human monitoring state and the initial comparison value A_i of the fixed heat source at each angle in the heat source scanning state, to provide initialization data for the next recognition, and the next step is proceeded;

S7, storing fixed heat source and static human body angles, including: resetting the accumulated alarm time, and storing the confirmed fixed heat source and static human body angles to prepare for the next time the user uses the kitchen; and

S8, performing a self-checking test, in which a self-checking button is pressed, at this time a "system self-checking" light is on, the controller first enters a "human body monitoring" state, and when an infrared receiver receives and can recognize a moving human body signal, a corresponding "human body monitoring" light is on, or otherwise the "human body monitoring" light is flashing, indicating that there is

a fault in this state; and the controller then enters the “heat source scanning” state, the gate screen supporting rod is driven to close by means of direct-current electromagnetic attraction, the stepper motor performs scanning motion, and when the infrared receiver receives a fixed heat source signal and can perform orientation recognition, a corresponding “heat source scanning” light is on, or otherwise the “heat source scanning” light is flashing.

As a preferred technical solution, in S1, the step of measuring the initialization data comprises the following sub-steps:

S11, entering a human body monitoring state, in which the controller of the apparatus first sends a control instruction to the driving circuit in the infrared detector to drive the gate screen execution mechanism to generate a pushing force, i.e. the direct-current electromagnet generates a magnetic pole with the same polarity as the permanent magnet on the gate screen supporting rod, so as to push the two gate screens to the position of the limiting baffle, such that the first gate screen and the second gate screen are both open, and at this moment, the infrared detector is at the 0° position, and the apparatus is in the human body monitoring state;

S12, collecting an initial comparison value V_n in the human body monitoring state, in which the controller then controls the stepper motor to step by +5° with a step angle of 1° and a stepping pulse frequency of 18 Hz and then return to the 0° position, and at the same time, an infrared data value V_n measured by the infrared detector in this state is stored in a data memory of the controller as the initial comparison value for recognizing that there is no person in the kitchen and no any fixed heat source is activated; and the infrared data value V_n is the initial comparison value V_n in the human body monitoring state;

S13, entering a heat source scanning state, in which the controller of the apparatus then sends a control instruction to the driving circuit in the infrared detector to drive the gate screen execution mechanism to generate an attraction force, i.e. the direct-current electromagnet generates a magnetic pole with the different polarity from the permanent magnet on the gate screen supporting rod, so as to attract the two gate screens to the position of the direct-current electromagnet

fixing frame, such that the first gate screen and the second gate screen are both closed, and at this moment, the infrared detector is at the 0° position, and the apparatus is in the heat source scanning state; and

S14, collecting an initial comparison value A_i of the fixed heat source at each angle in the heat source scanning state, in which the controller then controls the stepper motor to step by +90° with a step angle of 1° and a stepping pulse frequency of 18 Hz and then jump back to the 0° position, and at the same time, infrared data values A_{+1}, … A_{+i} …A_{+89}, A_{+90} measured by the infrared detector at an interval of 1° in this state are stored in the data memory of the controller; in the same way, the scanning is then performed from 0° to -90°, and infrared data values A_{-1}, …A_{-i}…A_{-89}, A_{-90} measured by the infrared detector at an interval of 1° in this state are stored in the data memory of the controller; and the infrared data value A_i is the initial comparison value A_i of the fixed heat source.

As a preferred technical solution, in S4, the step of recognizing whether the fixed heat source is activated when there is no person in the kitchen comprises the following sub-steps:

S41, switching the apparatus from the human body monitoring state in a mode of recognizing that a human body moves out into the human body monitoring state, and when a moving human body is monitored, performing a processing as if there is a person in the kitchen, and returning to the step S3, or otherwise proceeding to the next step;

S42, collecting and comparing the current infrared radiation value v_n within the sensing angle in the human body monitoring state, in which the controller then controls the stepper motor to step by +5° with a step angle of 1° and a stepping pulse frequency of 18 Hz and then return to the 0° position, and at the same time, the infrared data value v_n measured by the infrared detector in this state is stored and compared with the initial comparison value V_n that has been stored in the data memory and represents that there is no person in the kitchen and no any fixed heat source is activated, if $v_n > V_n$, indicating that there is no person in the kitchen and a fixed heat source is activated, and proceeding to the next recognition, or otherwise,

determining that there is no person in the kitchen and no any fixed heat source is activated, and returning to the step S2;

S43, collecting the heat source data from 0° to +90° in the heat source scanning state, in which the controller then controls the stepper motor to step by +90° with a step angle of 1° and a stepping pulse frequency of 18 Hz and then jump back to the 0° position, and at the same time, the infrared data values a_{+1}, … a_{+i} …a_{+89}, a_{+90} measured by the infrared detector at an interval of 1° in this state are stored in the data memory of the controller;

S44, entering the human body monitoring state and staying for time T1, and when a moving human body is monitored, performing a processing as if there is a person in the kitchen, and returning to the step S3, or otherwise proceeding to the next step;

S45, collecting the heat source data from 0° to -90° in the heat source scanning state, in which the same as the step S43, the controller then controls the stepper motor to step by -90° with a step angle of 1° and a stepping pulse frequency of 18 Hz and then jump back to the 0° position, and the infrared data values a_{-1}, …a_{-i}…a_{-89}, a_{-90} measured by the infrared detector at an interval of 1° in this state are stored in the data memory of the controller;

S46, entering the human body monitoring state and staying for time T2, and when a moving human body is monitored, performing a processing as if there is a person in the kitchen, and returning to the step S3, or otherwise proceeding to the next step;

S47, comparing the infrared radiation data of the fixed heat source at each angle, in which the infrared data value a_i of the heat source actually measured at each angle is compared with the initial comparison value A_i of the fixed heat source, if $a_i > A_i$, indicating that there is a fixed heat source at the angle i, or otherwise, indicating that there is no heat source, and returning to the step S4 for measurement of a_i in cycle; and the data a_i of each group are compared with the values of the last group, with the increased value indicating that the temperature of the heat source rises, or otherwise indicating that the temperature of the heat source falls, and the large value indicating that the temperature of the heat source is high; and after

continuous detection for N times, when the value of angle is greater than a set value, the angle is stored, and the next step is proceeded, or otherwise, when all the angle data are less than the set value, it is determined that there is no person in the kitchen and no any fixed heat source is activated, and the step S6 is proceeded; and

S48, recognizing a static human body in the kitchen, including: comparing the a_i of N times of continuous detection with the values of the last group, when the value a_i has an abrupt change that is less than or equal to A_i and remains unchanged, indicating that there is a static human body at the angle i, and after the human body leaves resulting in the abrupt change and decrease of the infrared radiation data thereof, performing a processing as if there is a person in the kitchen; or otherwise, proceeding to the next step.

Compared with the prior art, the present invention has the following advantages and effects.

1. The present invention can, by means of data analysis of two states, i.e. human body monitoring and heat source scanning, automatically recognize whether a person uses various heat sources in a kitchen, and when the human body leaves the kitchen while the heat source is not deactivated, can automatically determine a voice playing period according to the radiation intensity of the fixed heat source, and automatically play voice alarm information.

2. The present invention can control, by means of the controller, the gate screen to be switched between opening and closing, achieving the automatic switching between the two states, i.e. human body monitoring and heat source scanning, and solving the problem that the existing infrared monitoring apparatus cannot automatically recognize a static human body and fixed heat sources.

3. The present invention can collect and process radiation values of each orientation of the infrared detector by means of the controller in the heat source scanning state, achieving the automatic recognition of the orientation and radiation intensity of the fixed heat source.

4. The present invention is also suitable for the intelligent recognition of characteristics of a sitting or moving human body in a room, and can perform angle

location for a static human body in a room, achieving intelligent home control in the case of automatically recognizing that there is a person in a room and that there is no person in a room.

Brief Description of the Drawings

Fig. 1 is a schematic diagram of the circuit constitution of an apparatus for automatically monitoring heat sources in a home kitchen according to the present invention;

Fig. 2 is a structural side view of the apparatus for automatically monitoring heat sources in a home kitchen according to the present invention;

Fig. 3 is a structural front view of the apparatus for automatically monitoring heat sources in a home kitchen according to the present invention;

Fig. 4 is a structural schematic diagram of a gate screen execution mechanism of an infrared detector according to the present invention;

Fig. 5 is an exploded structural schematic diagram of the gate screen execution mechanism of the infrared detector according to the present invention;

Fig. 6 is a schematic diagram of the infrared detector operating in a heat source scanning state according to the present invention;

Fig. 7 is a schematic diagram of the infrared detector operating in a human body monitoring state according to the present invention;

Fig. 8 is a schematic diagram of the infrared detector operating in the human body monitoring state in a mode of recognizing that a moving human body enters according to the present invention;

Fig. 9 is a schematic diagram of the infrared detector operating in the human body monitoring state in a mode of recognizing that a moving human body moves out according to the present invention; and

Fig. 10 is a flowchart of a software program according to the present invention.

Description of reference numerals in the figures: 1. infrared detector; 2. box body; 3. stepper motor rotating shaft; 4. external signal-power wire; 5. stepper motor; 6. circuit board; 7. controller; 8. external speaker interface; 9. button; 10. status indicator; 11. 0° position gap; 12. 0° position light; 13. Fresnel lens; 14.

sensing angle; 15. direct-current electromagnet; 16. direct-current electromagnet fixing frame; 17. first hinge; 18. second hinge; 19. third hinge; 20. limiting baffle; 21. gate screen supporting rod; 22. permanent magnet; 23. gate screen; 24. dual-element pyroelectric infrared sensor; 25. first gate screen; 26. second gate screen; 27. gate screen gap.

Detailed Description of Embodiments

In order to make the objectives, technical solutions and advantages of embodiments of the invention clearer, the technical solutions in embodiments of the invention will be clearly and completely described below with reference to the accompanying drawings in the embodiments of the invention. Apparently, the described embodiments are part of, but not all of the embodiments of the invention. Based on the embodiments of the present invention, all other embodiments obtained by those of ordinary skill in the art without involving any inventive effort fall within the scope of protection of the present invention.

Embodiments:

The circuit constitution of an apparatus for automatically monitoring heat sources in a home kitchen is shown in Fig. 1, which comprises a controller, and a stepper motor control circuit, an infrared detector 1, a stepper motor 0° position recognition circuit, status indicator lights, buttons and a voice circuit, which are connected to the controller, wherein the stepper motor control circuit is connected to a stepper motor; and the infrared detector is configured to monitor a moving human body and detect the amount of infrared radiation from all fixed heat sources in the kitchen, and comprises a driving circuit, a dual-element pyroelectric infrared sensor, a filter amplifier, a gate screen execution mechanism and a Fresnel lens 13, the filter amplifier being connected to the controller, the dual-element pyroelectric infrared sensor being connected to the filter amplifier, the Fresnel lens being arranged at a front end of the dual-element pyroelectric infrared sensor, the driving circuit being connected to the controller, and the gate screen execution mechanism being connected to the driving circuit.

The structural diagrams of the apparatus for automatically monitoring heat sources in a home kitchen are shown in Figs. 2 and 3, which comprises an infrared detector 1 and a box body 2. The infrared detector 1 is connected to the box body 2 via a stepper motor rotating shaft 3, and the power supply for the infrared detector and the detected infrared radiation signals are connected to a circuit inside the box body through an external signal-power wire 4. The box body is internally provided with a stepper motor 5, a circuit board 6 and a controller 7; the bottom of a side face of the box body is provided with an external speaker interface 8; and a lower portion of a front face of the box body is provided with buttons 9, status indicators 10 and a 0° position gap 11. The buttons 9 comprise two buttons, i.e. “self-checking” and “on-off”, from the left to the right, and the status indicators 10 comprise “human body monitoring”, “heat source scanning” and “system self-checking” from the left to the right. A front face of the infrared detector is provided with a 0° position light 12.

The infrared detector is configured to monitor a moving human body and detect the amount of infrared radiation from all fixed heat sources in the kitchen.

The Fresnel lens is configured such that the infrared light rays radiated from the target are focused onto the dual-element pyroelectric infrared sensor located at the focal point of the lens by means of special concentric circular narrow bands on a mirror surface of the Fresnel lens, a sensing angle is divided into alternate “bright areas” and “dark areas”, and when a human body moves to the sensing angle, the continuous light pulse generated is radiated onto the dual-element pyroelectric infrared sensor.

The dual-element pyroelectric infrared sensor is configured to recognize a moving heat source. When there is no human body or heat source radiation infrared signal in the kitchen, incident infrared rays are not output at the dual-element sensor. When there is a static human body in the kitchen or a fixed heat source is activated, similar to the situation of the infrared ways incident from the outside, the sensor also has no output. When and only when a human body is moving in the kitchen or the infrared detector is moving, the dual-element pyroelectric infrared sensor

receives different infrared radiation and outputs pulse signals, with the amplitude of the pulse signals being proportional to the amount of the received infrared radiation.

The filter amplifier is configured to filter and amplify the weak pulse signals output by the dual-element pyroelectric infrared sensor, and the filter amplifier used has a model of BIS0001.

The driving circuit is controlled, under the control of the controller, to generate forward or reverse direct current to flow through a micro direct-current electromagnet, so as to generate an attraction force or a pushing force on the permanent magnet on the gate screen supporting rod to drive the gate screen supporting rod on the hinge to rotate, creating the switching between two states, i.e. human body monitoring and heat source scanning. The driving circuit is implemented by two push-pull power amplifier circuits composed of symmetrical NPN and PNP transistors in pairs.

As shown in Figs. 4 and 5, the gate screen execution mechanism is composed of a direct-current electromagnet 15, a direct-current electromagnet fixing frame 16, a first hinge 17, a second hinge 18, a third hinge 19, a limiting baffle 20, a gate screen supporting rod 21 and a permanent magnet 22. The direct-current electromagnet fixing frame 16, the limiting baffle 20, the gate screen supporting rod 21 and the permanent magnet 22 are all provided with screw fixing holes. The gate screen execution mechanism is configured, under the drive of the driving circuit, to achieve automatic switching between the two states, i.e. human body monitoring and heat source scanning.

The gate screen supporting rod is configured to receive moving human body target signals at the maximum sensing angle in the human body monitoring state, and forms a gate screen gap at the minimum sensing angle in the heat source scanning state for detecting the amount of infrared radiation of the heat source at each angle. The gate screen supporting rod is made of non-ferrous metal (e.g. an aluminum alloy), a circular permanent magnet is fixed by the root of the gate screen supporting rod by means of four screw fixing holes, the surface area of the circular permanent magnet is equal to the surface area of the direct-current electromagnet, two further screw fixing holes are configured for a fixed connection between the

gate screen supporting rod and the second hinge, and the gate screen 23 mounted under the gate screen supporting rod is made of black paper.

The limiting baffle is configured to limit the angle by which the gate screen supporting rod rotates around the second hinge as the axis. The limiting baffle is made of non-ferrous metal (e.g. an aluminum alloy), and two screw fixing holes are configured for the fixed connection between the limiting baffle and the first hinge.

The direct-current electromagnet is configured to generate an attraction force or a pushing force to drive the gate screen supporting rod to rotate into the two states. When current flows through the direct-current electromagnet in one direction, the magnetic pole generated is anisotropic with that of the permanent magnet, and the direct-current electromagnet attracts the gate screen supporting rod with the permanent magnet to rotate same to the position of the direct-current electromagnet, that is, the position in the heat source scanning state. On the contrary, when current flows through the direct-current electromagnet in the other direction, the magnetic pole generated is isotropic with that of the permanent magnet, the direct-current electromagnet pushes the gate screen supporting rod with the permanent magnet to rotate same to the position of the limiting baffle, that is, the position in the human body monitoring state. The direct-current electromagnet is fixed onto the direct-current electromagnet fixing frame, the direct-current electromagnet fixing frame is made of non-ferrous metal (e.g. an aluminum alloy), the direct-current electromagnet is fixed by means of four screw fixing holes, and two further screw fixing holes are configured for the fixed connection between the direct-current electromagnet fixing frame and the third hinge. The first hinge, the second hinge and the third hinge are connected in the form of a coaxial cylindrical stack.

The hinges are configured such that the three portions, i.e. the direct-current electromagnet fixing frame, the limiting baffle and the gate screen supporting rod, are connected as a whole. The first hinge is coaxial with the third hinge and is fixed onto the box body of the infrared detector, the limiting baffle on the first hinge forms a gate screen rotation angle with the direct-current electromagnet fixing frame on the third hinge, and the gate screen rotation angle is related to the sensing

angle of the infrared detector, where the gate screen rotation angle = 90 - the maximum sensing angle/2.

The stepper motor uses a 28BYJ48 stepper motor driven by a ULN2003 driver. When the stepping driver ULN2003 receives a pulse signal sent by the controller, the stepper motor control circuit drives the stepper motor to drive the infrared detector to perform forward or reverse rotation by a corresponding angle in a set stepping direction, and controls the angular displacement of the stepper motor according to the number of pulses output under the control of the controller, so as to achieve the purpose of directional collection of infrared radiation data at each angle. The stepper motor 0° position recognition circuit is composed of an LED light on a center line of the infrared detector, and a photoresistor in a 0° position gap on a center line of the box body. Only when the stepper motor drives the center line of the infrared controller to rotate to coincide with the center line of the box body, the photoresistor on the box body circuit board can receive light rays from the LED, achieving the 0° position recognition. The LED light on the center line of the infrared detector is a 0° position light.

The voice circuit uses an ISD1700 voice chip. The chip contains all-round integrated system functions such as automatic gain control, microphone pre-amplifier, speaker drive line, oscillator, and memory. The chip uses an analog signal direct storage technique, and can permanently save a voice alarm signal recorded in advance. When playing, under the control of the controller, it will automatically perform periodic segmented playing according to the degree of danger of the fixed heat source in the situation in which there is no person in the kitchen. The external speaker is connected to the speaker drive line in the voice circuit, and is configured for connecting to a living room and other rooms outside the kitchen, such that a user can hear the voice alarm at any time and handle the dangerous situation in the kitchen in time.

The controller uses an STC15F2K60S2 single-chip microcomputer. The STC15F2K60S2 single-chip microcomputer, in addition to a large capacity, fast speed, and wide operating voltage, mainly because it has a large-capacity on-chip EEPROM (FLASH), can be used to store current infrared radiation data at each

angle and previous infrared radiation data at each angle, and store the voice playing period, the accumulated time in the situation in which there is no person and there is a stove fire in the kitchen, etc. according to the infrared data of the fixed heat source; The controller is internally provided with a high-speed 8-channel 10-bit ADC, and can be used to directly collect infrared radiation data of the infrared detector at different angles in the heat source scanning state, etc.

The button circuit is arranged at a lower end of the box body. There are two buttons on the monitoring apparatus, i.e. a power supply on-off button and a self-checking button of the apparatus. The status indicators use three LED lights to respectively indicate three operating states, i.e. “heat source scanning”, “human body monitoring” and “system self-checking”. The power supply on-off button is pressed, and the apparatus is powered on. If it is necessary to check whether the monitoring and alerting apparatus is operating properly, the self-checking button is pressed, at this time a “system self-checking” light is on, the apparatus first enters a “human body monitoring” state, and when an infrared receiver receives and can recognize a moving human body signal, a corresponding “human body monitoring” light is on, or otherwise the “human body monitoring” light is flashing, indicating that there is a fault in this state. The apparatus automatically enters the heat source scanning state after detecting the human body monitoring state, the direct-current electromagnet attracts the gate screen to close, the stepper motor performs scanning motion, and when the infrared receiver receives the fixed heat source signal and can perform orientation recognition, the corresponding “heat source scanning” light is on, or otherwise, “heat source scanning” is flashing, indicating that there is a fault in this state.

The power supply is implemented by an on-off power module and is configured to generate +5V power supply and +12V power supply; the +5V power supply supplies power to the controller, the stepper motor control circuit, the stepper motor 0° position recognition circuit, the status indicator lights, the voice circuit and the stepper motor, which are located inside the box body; and the +12V power supply supplies power to the infrared detector through an external signal-power wire.

In this embodiment, the infrared detector is modified based on the basic principle of the infrared detector rotating to detect a fixed heat source. The infrared detector is installed as a whole on the rotating shaft of the stepper motor above the box body to realize the rotation of the infrared detector from 0° (i.e. in the middle position) to +90° (i.e. turning right to 90°) and to -90° (i.e. turning left to 90°) to scan and store the radiation signal data of the fixed heat source at each angle in the kitchen.

The box body is hung on a wall of the kitchen during engineering installation. The installation position should face away from the sun, with a wider field of view and a high distance from the ground. The specific position depends on the site at the entrance of the kitchen, as long as there is a kitchen entrance facing the left side of the apparatus.

The schematic diagram of the infrared detector operating in the heat source scanning state is as shown in Fig. 6, the schematic diagram of the infrared detector operating in the human body monitoring state is as shown in Fig. 7, the schematic diagram of the infrared detector operating in the human body monitoring state in a mode of recognizing that a moving human body enters is as shown in Fig. 8, and the schematic diagram of the infrared detector operating in the human body monitoring state in a mode of recognizing that a human body moves out is as shown in Fig. 9. The infrared detector is composed of a 0° position LED light, a driving circuit, a dual-element pyroelectric infrared sensor, a filter amplifier, a gate screen execution mechanism, and a cylindrical Fresnel lens. The dual-element pyroelectric infrared sensor 24 is located at the focal point of the cylindrical Fresnel lens 13 such that the infrared light rays radiated from the target are focused onto the sensor. The width of the gate screen gap 27 is the width of two “bright areas” with one “dark area” therebetween, so as to ensure that the amount of infrared radiation of the heat source within the corresponding angle, i.e. the sensing angle 14, during the heat source scanning can be effectively received by the sensor. The controller controls the direct-current electromagnet 15 on the gate screen execution mechanism by means of the driving circuit, and at the same time cooperates with the first hinge 17, the second hinge 18 and the limiting baffle 20 to achieve the opening and closing

operations of the first gate screen 25 and the second gate screen 26. In Fig. 8, the direction of arrow is the direction in which the human body enters from a kitchen door. In Fig. 9, the direction of arrow is the direction in which the human body moves out from the kitchen door.

In this embodiment, a monitoring method for automatically monitoring heat sources in a home kitchen comprises the following steps:

S1, performing power-on initialization, in which when no person enters a kitchen, and fixed heat sources in the kitchen are all deactivated, a power button of the apparatus is pressed, and the system first measures initialization data;

S11, entering a human body monitoring state, in which the controller of the apparatus first sends a control instruction to the driving circuit in the infrared detector to drive the gate screen execution mechanism to generate a pushing force, i.e. the direct-current electromagnet generates a magnetic pole with the same polarity as the permanent magnet on the gate screen supporting rod, so as to push the two gate screens to the position of the limiting baffle, such that the first gate screen and the second gate screen are both open, and at this moment, the infrared detector is at the 0° position, and the apparatus is in the human body monitoring state; the schematic diagram of the infrared detector operating in the human body monitoring state is as shown in Fig. 7;

S12, collecting an initial comparison value V_n in the human body monitoring state, in which the controller then controls the stepper motor to step by +5° with a step angle of 1° and a stepping pulse frequency of 18 Hz and then return to the 0° position, and at the same time, an infrared data value V_n measured by the infrared detector in this state is stored in a data memory of the controller as the initial comparison value for recognizing that there is no person in the kitchen and no any fixed heat source is activated; and the infrared data value V_n is the initial comparison value V_n in the human body monitoring state;

S13, entering a heat source scanning state, in which the controller of the apparatus then sends a control instruction to the driving circuit in the infrared detector to drive the gate screen execution mechanism to generate an attraction force, i.e. the direct-current electromagnet generates a magnetic pole with the

different polarity from the permanent magnet on the gate screen supporting rod, so as to attract the two gate screens to the position of the direct-current electromagnet fixing frame, such that the first gate screen and the second gate screen are both closed, and at this moment, the infrared detector is at the 0° position, and the apparatus is in the heat source scanning state; and

S14, collecting an initial comparison value A_i of the fixed heat source at each angle in the heat source scanning state, in which the controller then controls the stepper motor to step by +90° with a step angle of 1° and a stepping pulse frequency of 18 Hz and then jump back to the 0° position, and at the same time, infrared data values A_{+1}, … A_{+i} …A_{+89}, A_{+90} measured by the infrared detector at an interval of 1° in this state are stored in the data memory of the controller; in the same way, the scanning is then performed from 0° to -90°, and infrared data values A_{-1}, …A_{-i}…A_{-89}, A_{-90} measured by the infrared detector at an interval of 1° in this state are stored in the data memory of the controller; and the infrared data value A_i is the initial comparison value A_i of the fixed heat source.

S2, recognizing that a moving human body target enters the kitchen, in which after the power-on initialization, the system proceeds to a human body monitoring state; when a person enters the kitchen, the dual-element pyroelectric infrared sensor receives infrared radiation pulse signals of the moving human body, the infrared radiation pulse signals are filtered, amplified and then transferred to the controller for signal processing, and after determining that there is a moving human body target within a human body sensing angle, the controller of the apparatus sends a control instruction to the driving circuit in the infrared detector, to drive the direct-current electromagnet to generate a magnetic pole with the different polarity from a permanent magnet on a gate screen supporting rod, such that a second gate screen is attracted to the position of the direct-current electromagnet fixing frame, i.e. being closed, while a first gate screen remains open, reducing the sensing angle by half; the schematic diagram of the infrared detector operating in the human body monitoring state in the mode of recognizing that a moving human body enters is as shown in Fig. 8; and if the human body target can be still monitored, indicating that a human body enters the kitchen, the apparatus does not give an alarm about the

heat sources, or otherwise performs a processing as if no human body enters the kitchen, and returns to the human body monitoring state;

S3, recognizing that the moving human body target moves out of the kitchen, in which after determining that the human body enters the kitchen, the controller of the apparatus sends a control instruction to the driving circuit in the infrared detector, and in contrast to the process of the step S2, the first gate screen is attracted to the position of the direct-current electromagnet fixing frame, i.e. being closed, while the second gate screen remains open, reducing the sensing angle by half; and the schematic diagram of the infrared detector operating in the human body monitoring state in the mode of recognizing that a human body moves out is as shown in Fig. 9; and if the human body target can be monitored, indicating that the moving human body moves out of the kitchen, or otherwise performs a processing as if there is a person in the kitchen, and returns to the human body monitoring state;

S4, recognizing whether a fixed heat source is activated when there is no person in the kitchen, including: first, determining whether there is no person in the kitchen in the human body monitoring state, and when it is monitored that there is no person in the kitchen, starting to recognize the activated state of the fixed heat source in the kitchen;

S41, switching the apparatus from the human body monitoring state in a mode of recognizing that a human body moves out into the human body monitoring state, and when a moving human body is monitored, performing a processing as if there is a person in the kitchen, and returning to the step S3, or otherwise proceeding to the next step;

S42, collecting and comparing the current infrared radiation value v_n within the sensing angle in the human body monitoring state, in which the controller then controls the stepper motor to step by +5° with a step angle of 1° and a stepping pulse frequency of 18 Hz and then return to the 0° position, and at the same time, the infrared data value v_n measured by the infrared detector in this state is stored and compared with the initial comparison value V_n that has been stored in the data memory and represents that there is no person in the kitchen and no any fixed heat

source is activated, if $v_n > V_n$, indicating that there is no person in the kitchen and a fixed heat source is activated, and proceeding to the next recognition, or otherwise, determining that there is no person in the kitchen and no any fixed heat source is activated, and returning to the step S2;

S43, collecting the heat source data from 0° to +90° in the heat source scanning state, in which the controller then controls the stepper motor to step by +90° with a step angle of 1° and a stepping pulse frequency of 18 Hz and then jump back to the 0° position, and at the same time, the infrared data values a_{+1}, … a_{+i} …a_{+89}, a_{+90} measured by the infrared detector at an interval of 1° in this state are stored in the data memory of the controller;

S44, entering the human body monitoring state and staying for time T1, and when a moving human body is monitored, performing a processing as if there is a person in the kitchen, and returning to the step S3, or otherwise proceeding to the next step;

S45, collecting the heat source data from 0° to -90° in the heat source scanning state, in which the same as the process of the step S43, the controller then controls the stepper motor to step by -90° with a step angle of 1° and a stepping pulse frequency of 18 Hz and then jump back to the 0° position, and the infrared data values a_{-1}, …a_{-i}…a_{-89}, a_{-90} measured by the infrared detector at an interval of 1° in this state are stored in the data memory of the controller;

S46, entering the human body monitoring state and staying for time T2, and when a moving human body is monitored, performing a processing as if there is a person in the kitchen, and returning to the step S3, or otherwise proceeding to the next step;

S47, comparing the infrared radiation data of the fixed heat source at each angle, in which the infrared data value a_i of the heat source actually measured at each angle is compared with the initial comparison value A_i of the fixed heat source, if $a_i > A_i$, indicating that there is a fixed heat source at the angle i, or otherwise, indicating that there is no heat source, and returning to the step S4 for measurement of a_i in cycle; and the data a_i of each group are compared with the values of the last group, with the increased value indicating that the temperature of the heat source

rises, or otherwise indicating that the temperature of the heat source falls, and the large value indicating that the temperature of the heat source is high; and after continuous detection for N times, when the value of angle is greater than a set value, the angle is stored, and the next step is proceeded, or otherwise, when all the angle data are less than the set value, it is determined that there is no person in the kitchen and no any fixed heat source is activated, and the step S6 is proceeded; and

S48, recognizing a static human body in the kitchen, including: comparing the a_i of N times of continuous detection with the values of the last group, when the value a_i has an abrupt change that is less than or equal to A_i at some point and remains unchanged, indicating that there is a static human body at the angle i, and after the human body leaves resulting in the abrupt change and decrease of the infrared radiation data thereof, performing a processing as if there is a person in the kitchen; or otherwise, proceeding to the next step.

S5, recognizing the degree of danger of the heat source and automatically giving a voice alarm, in which when a stove fire on the fixed heat source within the sensing angle is in a high level, the amount of infrared radiation is large, the collected infrared data is large, and when the value of a_i of N times of continuous detection is beyond a set maximum value, the controller automatically reduces the set playing time period of the voice circuit, and when the set playing time is reached, the controller controls the connection of the voice circuit to a speaker outside the kitchen via a lead at a speaker interface to give an alarm “Your kitchen’s stove fire is on and in a high level, and you have left the kitchen for XX minutes, please watch out for the stove fire”; when the stove fire is in a low level, the amount of infrared radiation is small, the collected infrared data is small, and when the value of a_i of N times of continuous detection is beyond a set minimum value, the controller automatically extends the set playing time period of the voice circuit, and when the set playing time is reached, the controller controls the connection of the voice circuit to the speaker outside the kitchen via the lead at the speaker interface to give an alarm “Your kitchen’s stove fire is on and in a low level, and you have left the kitchen for XX minutes, please watch out for the stove fire”; and when the stove fire is in a medium level, the amount of infrared radiation is medium, the collected

infrared data is at an intermediate value, and when the value of a_i of N times of continuous detection is beyond a set intermediate value, the controller automatically set the set playing time period of the voice circuit to be moderate, and when the set playing time is reached, the controller controls the connection of the voice circuit to the speaker outside the kitchen via the lead at the speaker interface to give an alarm "Your kitchen's stove fire is on and in a medium level, and you have left the kitchen for XX minutes, please watch out for the stove fire";

S6, recollecting and updating the initialization data, in which when it is determined in step S4 that there is no person in the kitchen and no any fixed heat source is activated, since the current environment has uncertainties including the sunlight infrared radiation, the temperature difference between day and night, and the opening and closing of a kitchen window, the initial comparison value will change and need to be re-measured with the same method as in step S1, and the original values are overwritten with the re-measured initial comparison value V_n in the human monitoring state and the initial comparison value A_i of the fixed heat source at each angle in the heat source scanning state, to provide initialization data for the next recognition, and the next step is proceeded;

S7, storing fixed heat source and static human body angles, including: resetting the accumulated alarm time, and storing the confirmed fixed heat source and static human body angles to prepare for the next time the user uses the kitchen; and

S8, performing a self-checking test, in which a self-checking button is pressed, at this time a "system self-checking" light is on, the controller first enters a "human body monitoring" state, and when an infrared receiver receives and can recognize a moving human body signal, a corresponding "human body monitoring" light is on, or otherwise the "human body monitoring" light is flashing, indicating that there is a fault in this state; and the controller then enters the "heat source scanning" state, the gate screen supporting rod is driven to close by means of direct-current electromagnetic attraction, the stepper motor performs scanning motion, and when the infrared receiver receives a fixed heat source signal and can perform orientation recognition, a corresponding "heat source scanning" light is on, or otherwise the "heat source scanning" light is flashing.

In this embodiment, the software program flowchart is as shown in Fig. 10, and the software design comprises the following steps:

1. performing program initialization

mainly performing initial configuration on internal resources of the controller, including a reset source, a clock, a serial port, AD, an external memory, a voltage reference, a port, a crystal oscillator, an interrupter, etc., with the purpose of preparing for the normal operation of the controller;

2. finding the motor starting 0° position

having the main function of finding the 0° boundary of the stepper motor when the stepper motor rotates at 18°/s in a reciprocating manner in a range of ±90° as the starting point for the program to collect infrared radiation data in a sensing angle range of the infrared detector; and

3. collecting dynamic initialization comparison data

mainly collecting environmental data in two states in a dynamic sensing angle range of the infrared detector.

The above-mentioned examples merely represent several embodiments of the present invention, giving specifics and details thereof, but should not be understood as limiting the scope of the present patent of invention thereby. It should be noted that a person of ordinary skill in the art could also make several alterations and improvements without departing from the spirit of the present invention and these would all fall within the scope of protection of the present invention. Therefore, the scope of protection of the present patent of invention shall be defined by the claims.

Claims

1. An apparatus for automatically monitoring heat sources in a home kitchen, comprising a controller, and a stepper motor control circuit, an infrared detector, a stepper motor 0° position recognition circuit, status indicator lights, buttons and a voice circuit, which are connected to the controller, wherein the stepper motor control circuit is connected to a stepper motor; the infrared detector is configured to monitor a moving human body and detect the amount of infrared radiation from all fixed heat sources in the kitchen, and comprises a driving circuit, a dual-element pyroelectric infrared sensor, a filter amplifier, a gate screen execution mechanism and a Fresnel lens, the filter amplifier being connected to the controller, the dual-element pyroelectric infrared sensor being connected to the filter amplifier, the Fresnel lens being arranged at a front end of the dual-element pyroelectric infrared sensor, the driving circuit being connected to the controller, and the gate screen execution mechanism being connected to the driving circuit; the driving circuit is configured, under the control of the controller, to generate forward and reverse direct current flowing through a direct-current electromagnet; the gate screen execution mechanism is configured, under the drive of the driving circuit, to achieve automatic switching between two states, i.e. human body monitoring and heat source scanning; the dual-element pyroelectric infrared sensor is configured to recognize a moving heat source; and the Fresnel lens is configured such that infrared light rays radiated from a target are focused onto the dual-element pyroelectric infrared sensor located at the focal point of the lens, the dual-element pyroelectric infrared sensor is configured to recognize the moving heat source, and the filter amplifier is configured to filter and amplify weak pulse signals output by the dual-element pyroelectric infrared sensor.

2. The apparatus for automatically monitoring heat sources in a home kitchen according to claim 1, wherein the Fresnel lens is configured such that the infrared light rays radiated from the target are focused onto the dual-element pyroelectric infrared sensor located at the focal point of the lens by means of concentric circular narrow bands on a mirror surface of the Fresnel lens, a sensing

angle is divided into alternate “bright areas” and “dark areas”, and when a human body moves to the sensing angle, the continuous light pulse generated is radiated onto the dual-element pyroelectric infrared sensor.

3. The apparatus for automatically monitoring heat sources in a home kitchen according to claim 1, wherein the gate screen execution mechanism comprises a direct-current electromagnet, a direct-current electromagnet fixing frame, a permanent magnet, a limiting baffle, a gate screen, a gate screen supporting rod, and three hinges, wherein the three hinges are connected in the form of a coaxial cylindrical stack; the direct-current electromagnet is arranged in the direct-current electromagnet fixing frame; the permanent magnet is fixed to a root of the gate screen supporting rod; a lower portion of the gate screen supporting rod is configured for mounting the gate screen; and the gate screen supporting rod is made of non-ferrous metal, a circular permanent magnet is fixed by the root of the gate screen supporting rod by means of four screw fixing holes, the surface area of the circular permanent magnet is equal to the surface area of the direct-current electromagnet, two further screw fixing holes are configured for a fixed connection between the gate screen supporting rod and the second hinge, and the gate screen mounted under the gate screen supporting rod is made of black paper to reduce the weight of the gate screen.

4. The apparatus for automatically monitoring heat sources in a home kitchen according to claim 1, wherein the filter amplifier has a model of BIS0001; the stepper motor uses a 28BYJ48 stepper motor driven by a ULN2003 driver; the voice circuit uses an ISD1700 voice chip; and the controller uses an STC15F2K60S2 single-chip microcomputer.

5. The apparatus for automatically monitoring heat sources in a home kitchen according to claim 1, wherein the controller, the voice circuit, and the stepper motor 0° position recognition circuit are arranged in a housing, and the status indicator lights and the buttons are arranged on a front panel of the housing;

and the infrared detector is connected to a stepper motor in the housing via a stepper motor rotating shaft.

6. The apparatus for automatically monitoring heat sources in a home kitchen according to claim 5, wherein the stepper motor 0° position recognition circuit is composed of an LED light on a center line of the infrared detector, and a photoresistor in a 0° position gap on a center line of a box body; the LED light on the center line of the infrared detector is a 0° position light;

the buttons are arranged at a lower end of the box body; and the status indicators use three LED lights to respectively indicate three operating states, i.e. “heat source scanning”, “human body monitoring” and “system self-checking”.

7. The apparatus for automatically monitoring heat sources in a home kitchen according to claim 1, further comprising a power supply for supplying power to a monitoring and alerting apparatus, wherein the power supply is implemented by an on-off power module and is configured to generate +5V power supply and +12V power supply; the +5V power supply supplies power to the controller, the stepper motor control circuit, the stepper motor 0° position recognition circuit, the status indicator lights, the voice circuit and the stepper motor, which are located inside the box body; and the +12V power supply supplies power to the infrared detector through an external signal-power wire.

8. A monitoring method for the apparatus for automatically monitoring heat sources in a home kitchen according to any one of claims 1-7, comprising the following steps:

S1, performing power-on initialization, in which when no person enters a kitchen, and fixed heat sources in the kitchen are all deactivated, a power button of the apparatus is pressed, and the system first measures initialization data;

S2, recognizing that a moving human body target enters the kitchen, in which after the power-on initialization, the system proceeds to a human body monitoring state; when a person enters the kitchen, the dual-element pyroelectric infrared

sensor receives infrared radiation pulse signals of the moving human body, the infrared radiation pulse signals are filtered, amplified and then transferred to the controller for signal processing, and after determining that there is a moving human body target within a sensing angle, the controller of the apparatus sends a control instruction to the driving circuit in the infrared detector, to drive the direct-current electromagnet to generate a magnetic pole with the different polarity from a permanent magnet on a gate screen supporting rod, such that a second gate screen is attracted to the position of the direct-current electromagnet fixing frame, i.e. being closed, while a first gate screen remains open, reducing the sensing angle by half; and when the human body target is monitored again, indicating that a human body enters the kitchen, the apparatus does not give an alarm about the heat sources, or otherwise performs a processing as if no human body enters the kitchen, and returns to the human body monitoring state;

S3, recognizing that the moving human body target moves out of the kitchen, in which after determining that the human body enters the kitchen, the controller of the apparatus sends a control instruction to the driving circuit in the infrared detector, and in contrast to the process of the step S2, the first gate screen is attracted to the position of the direct-current electromagnet fixing frame, i.e. being closed, while the second gate screen remains open, reducing the sensing angle by half; and when the human body target is monitored again, indicating that the moving human body moves out of the kitchen, or otherwise performs a processing as if there is a person in the kitchen, and returns to the human body monitoring state;

S4, recognizing whether a fixed heat source is activated when there is no person in the kitchen, including: first, determining whether there is no person in the kitchen in the human body monitoring state, and when it is monitored that there is no person in the kitchen, starting to recognize the activated state of the fixed heat source in the kitchen;

S5, recognizing the degree of danger of the heat source and automatically giving a voice alarm, in which when a stove fire on the fixed heat source within the sensing angle is in a high level, the amount of infrared radiation is large, the

collected infrared data is large, and when the value of a_i of N times of continuous detection is beyond a set maximum value, the controller automatically reduces the set playing time period of the voice circuit, and when the set playing time is reached, the controller controls the connection of the voice circuit to a speaker outside the kitchen via a lead at a speaker interface to give an alarm "Your kitchen's stove fire is on and in a high level, and you have left the kitchen for XX minutes, please watch out for the stove fire"; when the stove fire is in a low level, the amount of infrared radiation is small, the collected infrared data is small, and when the value of a_i of N times of continuous detection is beyond a set minimum value, the controller automatically extends the set playing time period of the voice circuit, and when the set playing time is reached, the controller controls the connection of the voice circuit to the speaker outside the kitchen via the lead at the speaker interface to give an alarm "Your kitchen's stove fire is on and in a low level, and you have left the kitchen for XX minutes, please watch out for the stove fire"; and when the stove fire is in a medium level, the amount of infrared radiation is medium, the collected infrared data is at an intermediate value, and when the value of a_i of N times of continuous detection is beyond a set intermediate value, the controller automatically set the set playing time period of the voice circuit to be moderate, and when the set playing time is reached, the controller controls the connection of the voice circuit to the speaker outside the kitchen via the lead at the speaker interface to give an alarm "Your kitchen's stove fire is on and in a medium level, and you have left the kitchen for XX minutes, please watch out for the stove fire";

S6, recollecting and updating the initialization data, in which when it is determined in step S4 that there is no person in the kitchen and no any fixed heat source is activated, since the current environment has uncertainties including the sunlight infrared radiation, the temperature difference between day and night, and the opening and closing of a kitchen window, the initial comparison value will change and need to be re-measured with the same method as in step S1, and the original values are overwritten with the re-measured initial comparison value V_n in the human monitoring state and the initial comparison value A_i of the fixed heat

source at each angle in the heat source scanning state, to provide initialization data for the next recognition, and the next step is proceeded;

S7, storing fixed heat source and static human body angles, including: resetting the accumulated alarm time, and storing the confirmed fixed heat source and static human body angles to prepare for the next time the user uses the kitchen; and

S8, performing a self-checking test, in which a self-checking button is pressed, at this time a "system self-checking" light is on, the controller first enters a "human body monitoring" state, and when an infrared receiver receives and can recognize a moving human body signal, a corresponding "human body monitoring" light is on, or otherwise the "human body monitoring" light is flashing, indicating that there is a fault in this state; and the controller then enters the "heat source scanning" state, the gate screen supporting rod is driven to close by means of direct-current electromagnetic attraction, the stepper motor performs scanning motion, and when the infrared receiver receives a fixed heat source signal and can perform orientation recognition, a corresponding "heat source scanning" light is on, or otherwise the "heat source scanning" light is flashing.

9. The monitoring method for the apparatus for automatically monitoring heat sources in a home kitchen according to claim 8, wherein in S1, the step of measuring the initialization data comprises the following sub-steps:

S11, entering a human body monitoring state, in which the controller of the apparatus first sends a control instruction to the driving circuit in the infrared detector to drive the gate screen execution mechanism to generate a pushing force, i.e. the direct-current electromagnet generates a magnetic pole with the same polarity as the permanent magnet on the gate screen supporting rod, so as to push the two gate screens to the position of the limiting baffle, such that the first gate screen and the second gate screen are both open, and at this moment, the infrared detector is at the 0° position, and the apparatus is in the human body monitoring state;

S12, collecting an initial comparison value V_n in the human body monitoring state, in which the controller then controls the stepper motor to step by +5° with a

step angle of 1° and a stepping pulse frequency of 18 Hz and then return to the 0° position, and at the same time, an infrared data value V_n measured by the infrared detector in this state is stored in a data memory of the controller as the initial comparison value for recognizing that there is no person in the kitchen and no any fixed heat source is activated; and the infrared data value V_n is the initial comparison value V_n in the human body monitoring state;

S13, entering a heat source scanning state, in which the controller of the apparatus then sends a control instruction to the driving circuit in the infrared detector to drive the gate screen execution mechanism to generate an attraction force, i.e. the direct-current electromagnet generates a magnetic pole with the different polarity from the permanent magnet on the gate screen supporting rod, so as to attract the two gate screens to the position of the direct-current electromagnet fixing frame, such that the first gate screen and the second gate screen are both closed, and at this moment, the infrared detector is at the 0° position, and the apparatus is in the heat source scanning state; and

S14, collecting an initial comparison value A_i of the fixed heat source at each angle in the heat source scanning state, in which the controller then controls the stepper motor to step by +90° with a step angle of 1° and a stepping pulse frequency of 18 Hz and then jump back to the 0° position, and at the same time, infrared data values A_{+1}, … A_{+i} …A_{+89}, A_{+90} measured by the infrared detector at an interval of 1° in this state are stored in the data memory of the controller; in the same way, the scanning is then performed from 0° to -90°, and infrared data values A_{-1}, …A_{-i}…A_{-89}, A_{-90} measured by the infrared detector at an interval of 1° in this state are stored in the data memory of the controller; and the infrared data value A_i is the initial comparison value A_i of the fixed heat source.

10. The monitoring method for the apparatus for automatically monitoring heat sources in a home kitchen according to claim 8, wherein in S4, the step of recognizing whether the fixed heat source is activated when there is no person in the kitchen comprises the following sub-steps:

S41, switching the apparatus from the human body monitoring state in a mode of recognizing that a human body moves out into the human body monitoring state, and when a moving human body is monitored, performing a processing as if there is a person in the kitchen, and returning to the step S3, or otherwise proceeding to the next step;

S42, collecting and comparing the current infrared radiation value v_n within the sensing angle in the human body monitoring state, in which the controller then controls the stepper motor to step by +5° with a step angle of 1° and a stepping pulse frequency of 18 Hz and then return to the 0° position, and at the same time, the infrared data value v_n measured by the infrared detector in this state is stored and compared with the initial comparison value V_n that has been stored in the data memory and represents that there is no person in the kitchen and no any fixed heat source is activated, if $v_n > V_n$, indicating that there is no person in the kitchen and a fixed heat source is activated, and proceeding to the next recognition, or otherwise, determining that there is no person in the kitchen and no any fixed heat source is activated, and returning to the step S2;

S43, collecting the heat source data from 0° to +90° in the heat source scanning state, in which the controller then controls the stepper motor to step by +90° with a step angle of 1° and a stepping pulse frequency of 18 Hz and then jump back to the 0° position, and at the same time, the infrared data values a_{+1}, … a_{+i} …a_{+89}, a_{+90} measured by the infrared detector at an interval of 1° in this state are stored in the data memory of the controller;

S44, entering the human body monitoring state and staying for time T1, and when a moving human body is monitored, performing a processing as if there is a person in the kitchen, and returning to the step S3, or otherwise proceeding to the next step;

S45, collecting the heat source data from 0° to -90° in the heat source scanning state, in which the same as the step S43, the controller then controls the stepper motor to step by -90° with a step angle of 1° and a stepping pulse frequency of 18 Hz and then jump back to the 0° position, and the infrared data values

a_{-1}, …a_{-i}…a_{-89}, a_{-90} measured by the infrared detector at an interval of 1° in this state are stored in the data memory of the controller;

S46, entering the human body monitoring state and staying for time T2, and when a moving human body is monitored, performing a processing as if there is a person in the kitchen, and returning to the step S3, or otherwise proceeding to the next step;

S47, comparing the infrared radiation data of the fixed heat source at each angle, in which the infrared data value a_i of the heat source actually measured at each angle is compared with the initial comparison value A_i of the fixed heat source, if $a_i > A_i$, indicating that there is a fixed heat source at the angle i, or otherwise, indicating that there is no heat source, and returning to the step S4 for measurement of a_i in cycle; and the data a_i of each group are compared with the values of the last group, with the increased value indicating that the temperature of the heat source rises, or otherwise indicating that the temperature of the heat source falls, and the large value indicating that the temperature of the heat source is high; and after continuous detection for N times, when the value of angle is greater than a set value, the angle is stored, and the next step is proceeded, or otherwise, when all the angle data are less than the set value, it is determined that there is no person in the kitchen and no any fixed heat source is activated, and the step S6 is proceeded; and

S48, recognizing a static human body in the kitchen, including: comparing the a_i of N times of continuous detection with the values of the last group, when the value a_i has an abrupt change that is less than or equal to A_i and remains unchanged, indicating that there is a static human body at the angle i, and after the human body leaves resulting in the abrupt change and decrease of the infrared radiation data thereof, performing a processing as if there is a person in the kitchen; or otherwise, proceeding to the next step.