FIG. 3 shows the auto calibration logic sequence used for sleep detection and driver alert apparatus 1. The sequence begins with initialization STEP 1, when the apparatus 1 is powered up. Then the auto focus infrared camera 6 takes continuous readings of eye pixel color thermal images, STEP 2. The thermal pixel color image is then recorded in STEP 3. The unit is self calibrating to any driver of different height and distance from the unit.

FIG. 4 in conjunction with FIG. 3 shows the use logic sequence used for sleep detection and driver alert apparatus 1. Initialization begins STEP 11 immediately upon the unit being powered up by the driver. The auto focus camera 6 focuses on the eyes and nose area of the driver continuously, STEP 20. In STEP 30, if head movement is not detected for more than five seconds, the sleep status detector 28 is signaled to analyze the current thermal pixel color image from the calibration memory 42. In STEP 50, the alarm circuit 46 compares the current color pixel count thermal image with the information in the calibration memory 42. In STEP 60, if the thermal pixel count output is determined to be less or greater than that of the calibration data for eyes-open pixel count, then the alarm circuit 46 will further analyze if the thermal signature pixel image is equal to that of the eye's closed data, STEP 70. Finally, if STEP 70 determines that the driver is sleepy by eyelids closing, in STEP 80 an audible alarm is sounded for 10 seconds, in order to wake the sleepy driver. It has been found that a sleepy driver can be determined by a fixed head position with color pixel count change from baseline and low breathing exhaled plume detection.

Operation of the Preferred Embodiment

In accordance with a preferred embodiment of the present invention, as shown in FIG. 5, the sleep detection and driver alert apparatus 1 is shown in use in an automobile 89 mounted on a rear-view mirror 90. The calibration is automatic.

While operating the vehicle, the sleep detection and driver alert apparatus 1 will continuously focus on the face/eye area to get an accurate image of the driver's eye and head movement. Monitoring the eye and head movement, approximately a five second eye closure would then trigger further detection of heat loss/gain with pixel count as compared with the calibrated auto baseline values. This will prevent false alarms resulting from hand movement, sunlight, or the like. A series of escalating audible alarms 94 are generated to alert or awaken the driver 92.

The foregoing description is included to illustrate the operation of the preferred embodiment and is not meant to limit the scope of the invention. From the foregoing description, many variations will be apparent to those skilled in the art that would yet be encompassed by the spirit and scope of the invention. The scope of the invention is to be limited only by the following claims.

What is claimed is:

1. A sleep detection and driver alert apparatus for sensing sleep or drowsiness in a driver of a motor vehicle or the like, comprising:

a. a containing housing suited to be attached to the rear view mirror or attached to the dashboard of an automobile;

b. an infrared, digital, auto-focus image stabilization zoom camera type lens;

c. thermal sensing means for sensing ambient heat output pixel color changes from a driver's facial mouth and eye area;

d. an optical motion detection circuit for sensing absence of motion from the output of said digital infrared auto-focus image stabilization zoom camera type lens;

e. digital, infrared thermal imaging means for determining changes in infrared thermal output between open and closed eye color pixel changes;

f. sleep status detection means for comparing the output of said optical motion detection circuit, and said thermal sensing means;

g. an auto calibration memory for storing alarm limit and range data for users of differing size, height, and other physical characteristics;

h. an alarm circuit for comparing the output of said sleep status detection means with previously stored calibration information; and

i. an audible alarm means for sounding an audible alarm.

2. The sleep detection and driver alert apparatus described in claim 1, wherein said thermal sensing means consists of a means for sensing and measuring thermal output color pixel changes located in the infrared range of the radiation spectrum.

3. The sleep detection and driver alert apparatus described in claim 1, wherein said thermal imaging means consist of an opto-electronic infrared imaging device.

4. The sleep detection and driver alert apparatus described in claim 1, wherein said digital infrared auto-focus image stabilization zoom camera lens has a range in focal length of between one foot and three feet.

5. The sleep detection and driver alert apparatus described in claim 1, wherein said sleep status detection means comprises a microprocessor logic controller.

6. The sleep detection and driver alert apparatus described in claim 1, wherein said alarm means comprises a simulated voice output generated to produce an escalating series of alarms based upon the frequency of the detected sleep episode.

7. A sleep detection apparatus for sensing sleep or drowsiness, comprising:

a. auto focusing sensing means for sensing an individual's face for detecting movement therefrom and generating an image therefrom;

b. an image stabilizer for stabilizing said image generated from said sensing means;

c. thermal imaging means for determining changes in heat output resulting from differences between open and closed eyes via pixel count and changes in lowered respiration rates by means of smaller exhaled plume and temperature variations;

d. an auto-calibration alarm limit and range data for users of differing size, height, and other physical characteristics;

e. an alarm circuit for comparing the output of said sleep status detection means with previously stored calibration information; and

f. an audible alarm means for sounding an audible alarm.

8. The sleep detection apparatus described in claim 7, wherein said thermal sensing means consists of a means for sensing and measuring thermal output located in the infrared range of the radiation spectrum for both temperature changes with heat in exhaled breath and pixel color changes in eye area when opened or closed.

9. The sleep detection apparatus described in claim 7, wherein said thermal imaging means consist of an opto-electronic infrared imaging device.

10. The sleep detection apparatus described in claim 7, wherein said sleep status detection means comprises a microprocessor logic controller.

11. The sleep detection apparatus described in claim 7, wherein said audible alarm means comprises a simulated voice output generated to produce an escalating series of alarms based upon the frequency of the detected sleep episodes.

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