METHOD AND SYSTEM FOR MONITORING CONDITIONS IN MYOPIA PREVENTION APPLICATIONS

Field of the Invention

[0001] The present invention relates to a method and system for monitoring conditions attributable to causing near sightedness in users viewing a screen or monitor in myopia prevention applications. In particular, the method and system utilizes a digital imaging device such as a digital camera for capturing an image of a reference object or marker to determine the conditions such as distance from the screen or monitor, level of illumination of ambient light, direction of dominant illumination of ambient light, and flickering of illumination.

Background of the Invention

[0002] The using of desktop computers in our daily lives has caused the condition of near sightedness to become more commonplace. Users who spend several hours a day in front of computer monitors performing work or play, are more prone to being near sighted. This is often caused by the user's lack of attention to the illumination conditions of ambient light and distances from their eyes to the computer monitors.

[0003] The same can be said of watching television where a user may spend hours staring at a television screen and not be aware that the distance of the screen from the eyes are for example too near. Or that the illumination levels of ambient light are insufficient.

[0004] Presently, some devices and gadgets aid in controlling viewing distances of children from being too close to a television screen. There are also software that may be installed on computers that monitor the usage of the computer for a predetermined duration of time. When the time duration expires, the software

installed forces the user to take a break and rest his eyes, by either preventing the computer to be used or by giving the user a warning.

[0005] While a variety of light meters exist which allows for the measuring of illumination and lighting levels, they are invariably expensive and are generally meant for use with cameras or in cameras.

[0006] At present, there is no single invention that can measure the distance of a user from a fixed point such as a computer screen, and measure ambient lighting conditions to ensure that the user does not unduly strain their eyes under sub-optimal viewing conditions, by providing indication means to warn the user when such sub-optimal viewing conditions are present.

[0007] Therefore, a need clearly exists for such a method and system for monitoring conditions attributable to causing near sightedness in users viewing a screen or monitor in myopia prevention applications.

Summary of the Invention

[0008] The present invention seeks to provide a method and system for monitoring conditions attributable to causing near sightedness in users viewing a screen or monitor, utilizes a digital imaging device such as a digital camera for capturing an image of a reference object or marker to determine the conditions such as distance from the screen or monitor, level of illumination of ambient light, direction of dominant illumination of ambient light, and flickering of illumination.

[0009] Accordingly, in one aspect, the present invention provides a system for monitoring a plurality of conditions attributable to causing near sightedness in a user viewing a screen, the system comprising: a marker that may be worn by a user; a digital imaging device installed near the screen; a frame grabber coupled to the digital imaging device for capturing a captured image comprising a digital image of the marker using the digital imaging device; a processor for controlling the system;

an image condition processing system for processing the captured image comprising the digital image of the marker and for monitoring the plurality of conditions; a user interface for providing indication means to the user when the plurality of conditions being monitored do not meet predetermined requirements; wherein the plurality of conditions comprises: distance of marker from digital imaging device; general illumination level of ambient light of marker; dominant direction of illumination of ambient light of marker; and presence of flickering of illumination of ambient light of marker.

[0010] In another aspect, the present invention provides, a method for monitoring a plurality of conditions attributable to causing near sightedness in a user viewing a screen, utilizing a marker worn by a user, a digital imaging device installed near the screen, and an image processing system, the method comprising the steps:

a) capturing an image of the user wearing the marker;
b) identifying the marker from captured image;
c) determining distance from the marker to the imaging device;
d) determining general illumination level and dominant illumination direction of ambient light surrounding the marker; and
e) determining presence of flickering of illumination.

Brief Description of the Drawings

[0011] A preferred embodiment of the present invention will now be more fully described, by way of example, with reference to the drawings of which:

[0012] FIG. 1 illustrates a set-up of a preferred embodiment in accordance with the present invention;

[0013] FIG.2 illustrates a functional block diagram of the set-up in FIG.1;

[0014] FIG.3 illustrates a marker of FIG.2;

[0015] FIG.4 illustrates a functional block diagram of the image condition processing system in FIG.2;

[0016] FIG.5 illustrates a flow chart of a method in accordance with the present invention;

[0017] FIG.6 illustrates a flow chart of the identifying marker step of FIG.5;

[0018] FIG.7 illustrates a flow chart of the determining distance step of FIG.5;

[0019] FIG.8 illustrates a flow chart of the determining illumination levels step of FIG.5; and

[0020] FIG.9 illustrates a flow chart of the determining flickering of illumination step of FIG.5.

Detailed Description of the Drawings

[0021] In the following description, details are provided to describe the preferred embodiment. It shall be apparent to one skilled in the art, however, that the invention may be practiced without such details. Some of these details may not be described at length so as not to obscure the invention.

[0022] The method and system in accordance with the present invention is able to derive useful information from a reference object such as a marker in accordance with the present invention, by using a digital imaging device such as a digital camera examples of which are simple web cams or mobile phone cameras. The information derived includes distance of the marker from the digital imaging device, illumination levels and dominant illumination directions of ambient light surrounding the marker. Information pertaining to distance allows the system in

the present invention to address the problem of maintaining a predetermined optimal viewing distance between the user and that of a viewing surface such as a computer monitor or television screen.

[0023] Referring to FIG.1, a set-up of a preferred embodiment in accordance with the present invention is shown. A user 2 is seated at a table in front of a computer monitor 5. The user 2 is wearing a marker 10 in accordance with the present invention. Mounted atop the computer monitor 5 is a web-cam 12 The web cam 12 is used to capture an image which comprises the marker 10. The captured image then undergoes analysis to obtain the required information of distance and illumination, so as to ascertain whether the user 2 is viewing the computer monitor 5 in optimal conditions. Anything less than these optimal conditions may increase the chances of the user 2 becoming near sighted or if already near sighted, increasing the severity. The system in accordance with the present invention would then notify the user 2 of these less than optimal conditions.

[0024] Referring to FIG.2, a functional block diagram of the set-up in FIG.1 is shown. The set-up in accordance with the preferred embodiment comprises a marker and vision system 15 and an image processing system 20. The marker and vision system 15 includes a digital imaging device such as a web cam 12, which provides a video signal representing the image of whatever the web cam 12 is directed at. The video signal is provided to a frame grabber 13 which, when triggered, captures a particular frame of the video signal, stores the pixel data of the captured image, and makes the stored pixel data available to the image processing system 20.

[0025] The image processing system 20 may comprise a computer running software programs that provide the desired functionality. The computer may be for an example a desktop computer such as a Pentium IV microprocessor powered machine. Typically, the desktop computer includes a processor 22 that is coupled to access and control the operation of the frame grabber 13. In addition, the processor 22 is coupled to memory storage means 24 which may comprise of

random access memory, read-only-memory, and one or more hard disk drives. The processor 22 is further coupled to a user interface 27 which allows a user 2 to interface with the computer or for the computer to provide information and indication means to the user 2.

[0026] The image processing system 20 further comprises an image condition processing system 30. The image condition processing system 30 processes the image data captured and extracts the information required in monitoring the optimal conditions for the viewing of the computer monitor 5.

[0027] The operation of the desktop computer is known to one skilled in the art, and will not be further elaborated here, except where such details assist in the description of the present invention. Furthermore, while the preferred embodiment refers to the image processing system 20 comprising a desktop computer, any intelligent device capable of providing similar functionalities may be used. Examples of such intelligent devices are PDAs such as a Palm Zire or mobile phones such as a Sony Ericsson K700i.

[0028] Referring to FIG.3, the marker 10 in accordance with the present invention comprises of a plurality of surfaces. The marker 10 comprises at least 4 marker faces 10a-d, each marker face 10a-d adapted and angled to reflect light from a desired direction. A front maker face 10a is substantially in a vertical plane and reflects light coming from the front of the marker 10. A right maker face 10b is angled such that light from the right side of the marker 10 is reflected to the front of the marker 10. A left marker face 10c is angled to reflect light coming from the right of the marker 10 to the front of the marker 10. Lastly, a top maker face 10d reflects light coming from the top of the marker 10 to the front of the marker 10.

[0029] By analyzing the light reflecting off the marker faces 10a-d, the general illumination level of the ambient light surrounding the marker 10 can be obtained. The dominant direction of illumination can also be ascertained by comparing the light reflected off the marker faces 10a-d.

[0030] While the marker 10 is preferably worn by the user 2 on his clothes, the marker 10 may also be mounted on any accessories that may be worn or carried by the user 2. An example of which is the mounting of the marker 10 on the frame of spectacles being worn by the user 2.

[0031] Referring to FIG.4, the image condition processing system 30 processes the image data captured and extracts the information required in monitoring the optimal conditions for the viewing of the computer monitor 5. The image condition processing system 30 comprises a marker identifier 40, a distance determinator 45, an illumination determinator 50 and an indication module 60.

[0032] The marker identifier 40 receives a captured image 35 from the frame grabber 13 via the processor 22 of the image processing system 20. The captured image 35 should comprise an image of the marker 10 being worn by the user 2. The marker identifier 40 upon receiving the captured image 35, processes the captured image 35 to identify the marker 10 and the marker faces 10a-d. The information from the marker identifier 40 is received by the distance determinator 45 and the illumination determinator 50 for further processing to obtain the conditions for monitoring.

[0033] The distance determinator 45 uses the information from the marker identifier 40 to perform calculations to compute the distance of the marker 10 from the web cam 12. This computed distance is also checked with a predetermined optimum viewing distance, and if the computed distance is not optimal, the user 2 is notified via indication means such as a visual and audio warning via the indicator module 60 and the user interface 27.

[0034] The illumination determinator 50 comprises an illumination level determinator 52, a dominant direction determinator 53 and a flickering determinator 54. The illumination level determinator 52 uses the information from the marker identifier 40 to determine the general illumination level of ambient light

surrounding the marker 10 worn by the user 2. The illumination level determinator 52 computes the mean intensity of light being reflected off the marker 10 in the captured image 35 and produces the general illumination level. If the computed general illumination level is not within a range of a predetermined optimal general illumination level, then the indicator module 60 is activated to warn the user of the non-optimal general illumination level.

[0035] The dominant illumination determinator 53 also uses the information from the marker identifier to determine the dominant direction of illumination surrounding the user 2 and the marker 10. The dominant illumination determinator 53 compares the intensity of light reflected off the marker faces 10a-d in the captured image 35 and by identifying the marker face 10a-d with the highest intensity of light reflected, is able to determine the domination direction of illumination. The only recommended optimal direction of illumination is from above and therefore the desired marker face 10a-d having the highest intensity of reflected light is the top maker face 10d. If any other marker face 10a-d is determined to have the highest intensity of reflected light, then an indication is also made to the user 2 to inform him of the undesirable or non-optimal dominant direction of illumination.

[0036] The flickering determinator 54 stores the values of the intensities of all the marker faces 10a-d over a predetermined period of time. A check is then conducted to ensure that there are fewer than a predetermined number of drastic changes in intensities of light reflected from the marker faces 10a-d. If the number of drastic changes in intensities of light is too high, an indication is then provided to warn the user 2 of the flickering of ambient light in his surroundings.

[0037] The indication module 60 serves to provide indication means to the user 2 to warn him of viewing conditions being sub-optimal. The indication module 60 may also advise the user of the specifics behind the sub-optimal conditions, for example if the general illumination level of ambient light is too high or low. The

indication means provided are also usually via the user interface 27 of the image processing system.

[0038] Referring to FIG,4 and FIG,5, the method 500 for monitoring conditions attributable to causing near sightedness in users viewing a screen or monitor starts with the capturing 510 of an image of the user 2 wearing the marker 10.

[0039] Next, the captured image 35 is sent to the marker identifier 40 where the step of identifying 515 of the marker 10 is performed. The captured image 35 should essentially comprise at least the image of the marker 10, else the captured image 35 is discarded and another image captured.

[0040] The step of determining 520 the distance of the marker 10 from the digital imaging device which in the present embodiment is a web cam 12 is then carried out. If the distance computed is below predetermined requirements, an indication 535 is provided to warn the user 2 that the optimal conditions are not met.

[0041] Following which, the step of determining 525 the general illumination level and dominant illumination direction is performed. Similarly, an indication 535 is provided to the user 2 if the general illumination level and/ or the dominant illumination direction are not optimal.

[0042] Lastly, the step of determining 530 flickering of illumination is carried out. Presence of flickering of ambient light will result in an indication 535 being provided to warn the user.

[0043] Referring to FIG.6, the step of identifying 515 the marker 10 further comprises the step of performing 555 image segmentation on the captured image 35. In this step, depending on the capability of the digital imaging device used, the outline of the marker 10 is captured. With a gray scale ("black and white") camera, the image intensity is used to distinguish the marker 10 from the background. If a

color camera is used, the red green blue (RGB) color components of the image captured is used to distinguish the marker 10.

[0044] Next, the step of performing 560 marker face extraction is carried out. Here, several known commercial edge detection algorithm are available, such as those used for reading vehicle license plates or markings, may be used. The known features and shape of the marker 10 in the captured image 35 is located and this thus confirms the presence of an image of the marker 10 in the captured image 35.

[0045] The image of the marker 10 in the captured image may not always be a direct frontal view of the marker 10. The image of the marker 10 may be tilted and may be at an angle from the front. Some algorithms for correction of up and down and lateral rotational offsets may have to be applied to correct the captured image 10.

[0046] Following which, the step of identifying 565 the marker faces 10a-d of the marker 10 is performed. Using similar algorithms as the previous step, the individual marker faces 10a-d are also identified.

[0047] Referring to FIG.7, the step of determining 520 the distance of the marker 10 from the digital imaging device further comprises the step of computing 610 the area of the image of the marker 10 in the captured image 35. Next, the step of computing 615 the distance of the marker 10 from the digital imaging device is performed. The distance of the marker 10 is computed by comparing the area of the image of the marker 10 in the captured image with a known area of the marker 10 at a known distance. The computed distance is then compared with a predetermined optimal viewing distance. If the computed distance is lower 620 than a predetermined optimal distance, then indication means is provided 625 to the user 2 to warn the user 2 that his viewing distance is too close.

[0048] The perimeter instead of the area of the image of the maker 10 may be used for the step of determining 520 the distance of the marker 10 from the digital

imaging device. Similarly, the distance of the marker 10 is computed by comparing the perimeter of the image of the marker 10 in the captured image with a known perimeter of the marker 10 at a known distance.

[0049] Referring to FIG.8, the step of determining 525 the general illumination level and dominant illumination direction, further comprises the step of determining 710 the illumination levels of all the marker faces 10a-d. The mean intensities of the light reflecting off all the marker faces 10a-d are then computed 715 to obtain the computed general illumination level 715.

[0050] The computed general illumination level is then checked with the range of predetermined optimal general illumination level. If the computed general illumination level is not within 720 range of the predetermined optimal general illumination level for a predetermined period of time, an indication is provided 725 to the user to warn him that the general illumination level of ambient light is inadequate and also if the general illumination level is too high or too low.

[0051] All the intensities of light reflected off all the marker faces 10a-d are known. The illumination levels of all the marker faces 10a-d are compared and if any marker face 10a-d other 730 than the top marker face 10d exhibits the highest illumination level or light intensity of light reflected, an indication 735 is provided to warn the user that the dominant direction of illumination is undesirable.

[0052] Referring to FIG.9, the step of determining 530 flickering of illumination comprises the step of storing 810 all the illumination levels of all marker faces 10a-d for all captured images 35 over a predetermined period of time. Next, the step of checking 815 all stored illumination levels of all marker faces 10a-d for a predetermined number of drastic changes in stored illumination levels.

[0053] If the number of drastic changes in stored illumination levels exceeds 820 the predetermined number, an indication is provided 825 to warn the user of flickering of ambient light.

[0054] The method and system in accordance with the present invention thus provides the monitoring of conditions attributable to causing near sightedness in users viewing a screen or monitor. While the present embodiments refer to a desktop computer and a computer monitor 5. The present invention may easily be modified for use with a PDA or mobile phone having a digital camera for monitoring any predetermined conditions for viewing a screen without departing from the scope of the present invention.

Claims

1. A system for monitoring a plurality of conditions attributable to causing near sightedness in a user viewing a screen, the system comprising:

a marker that may be worn by a user;

a digital imaging device installed near the screen;

a frame grabber coupled to the digital imaging device for capturing a captured image comprising a digital image of the marker using the digital imaging device;

a processor for controlling the system;

an image condition processing system for processing the captured image comprising the digital image of the marker and for monitoring the plurality of conditions;

a user interface for providing indication means to the user when the plurality of conditions being monitored do not meet predetermined requirements;

wherein the plurality of conditions comprises:

distance of marker from digital imaging device;

general illumination level of ambient light of marker;

dominant direction of illumination of ambient light of marker; and

presence of flickering of illumination of ambient light of marker.

2. The system in accordance with claim 1, wherein the image condition processing system further comprises:

a marker identifier for identifying the digital image of the marker in the captured image;

a distance determinator for determining the distance of the marker from the digital imaging device; and

an illumination determinator for determining the illumination conditions of ambient light of the marker.

3. The system in accordance with claim 2, wherein the illumination determinator further comprises:

an illumination level determinator for determining the general illumination level of ambient light of the marker;

a dominant illumination determinator for determining the dominant direction of illumination of ambient light of marker; and

a flickering determinator for determining presence of flickering of illumination of ambient light of marker.

4. The system in accordance with claim 2, wherein the image condition processing system further comprises an indication module for providing indication means to the user.

5. The system in accordance with claim 1, wherein the marker may further be mounted on an accessory worn by the user.

6. The system in accordance with claim 1, wherein the marker comprises at least four maker faces, each marker face adapted for reflecting light from a different direction to the front of the marker.

7. The system in accordance with claim 6, wherein the four marker faces comprises: a front marker face, a left maker face, a right marker face and a top marker face.

8. A method for monitoring a plurality of conditions attributable to causing near sightedness in a user viewing a screen, utilizing a marker worn by a user, a digital imaging device installed near the screen, and an image processing system, the method comprising the steps:

a) capturing an image of the user wearing the marker;

b) identifying the marker from captured image;

c) determining distance from the marker to the imaging device;

d) determining general illumination level and dominant illumination direction of ambient light surrounding the marker; and

e) determining presence of flickering of illumination.

9. The method in accordance with claim 8, wherein step b) further comprises the steps:

b1) performing image segmentation on captured image;

b2) performing marker face extraction; and

b3) identifying all marker faces.

10. The method in accordance with claim 8, wherein step c) further comprises the steps:

c1) computing area of image of the marker in the captured image;

c2) computing distance of the marker from the digital imaging device by comparing the area of the image of the marker with a known area of the marker at a known distance;

c3) comparing computed distance with predetermined optimal distance; and

c4) providing an indication to the user that user is too near the screen if computed distance is lower than the predetermined optimal distance.

11. The method in accordance with claim 8, wherein step c) further comprises the steps:

c1) computing perimeter of image of the marker in the captured image;

c2) computing distance of the marker from the digital imaging device by comparing the perimeter of the image of the marker with a known perimeter of the marker at a known distance;

c3) comparing computed distance with predetermined optimal distance; and

c4) providing an indication to the user that user is too near the screen if computed distance is lower than the predetermined optimal distance.

12. The method in accordance with claim 9, wherein step d) further comprises the steps:

d1) determining illumination levels of all marker faces;

d2) computing general illumination level of all marker faces;

d3) checking computed general illumination level with predetermined optimal general illumination level;

d4) providing an indication to warn user the general illumination level is inadequate if the computed general illumination level is not within the predetermined optimal general illumination level;

d5) comparing illumination levels of all marker faces; and

d6) providing an indication to user that dominant direction of illumination is undesirable if top marker face is not the marker face having the highest illumination level, then.

13. The method in accordance with claim 9, wherein step e) further comprises the steps:

e1) storing all the illumination levels of all marker faces for all captured images over a predetermined period of time;

e2) checking all the stored illumination levels of all the marker faces for a predetermined number of drastic changes in the stored illumination levels; and

e3) providing an indication to the user of flickering ambient light if the number of drastic changes in illumination levels exceed the predetermined number.