Omni-focus Video Camera

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Based on an entirely new principle, the Omni-focus Video Camera was invented by Professor Keigo Iizuka of the Department of Electrical and Computer Engineering of University of Toronto, Canada. Computer software of the camera was fabricated by Dr. David Wilkes, President of Wilkes Associates Inc. 800 Teston Road, Maple, Ontario, Canada.

Background

Since its invention in 1839 by Louis Daguerre in France, photography has suffered from the limitation that if the foreground objects in a picture are focused, others in the background are out of focus. The proposed camera removes this limitation.

We will briefly explain why we consider this to be a significant scientific advance. Taking the example of a music concert scene being recorded for a TV program, even though the singer is in sharp focus, the members of the band in the background are almost always out of focus. This is true even with major national television stations. Conventional video cameras cannot focus both the singer and the members of the band in the background at the same time. The Omni-Focus Video Camera removes this limitation. All objects, near or far, multiple or single, in the scene are in focus with high image quality without physically moving optics in the camera in order to focus. The implications are far reaching. Millions of world TV audiences would enjoy higher quality video images in TV programs.

Achieved Results

Using a prototype consisting of two color video cameras, the resulting image shown in Figure 1a clearly demonstrates how the omni-focused output dramatically differs from that of a conventional camera, shown in Figure 1b. Note that in the omni-focused image, the fingers in the foreground are sharply focused such that even the fingerprints are easily recognized.

(a) By Omni-focus Video Camera (b) By Sony Handycam DCR-PC55

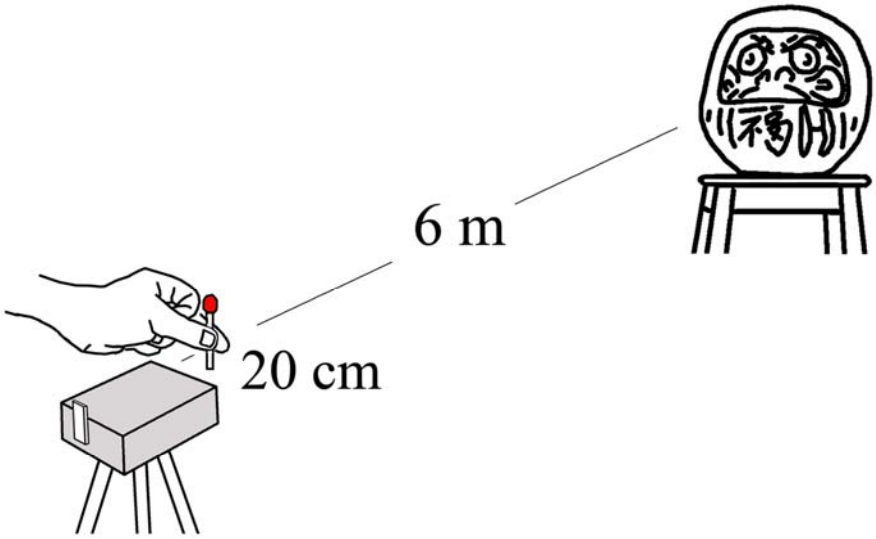
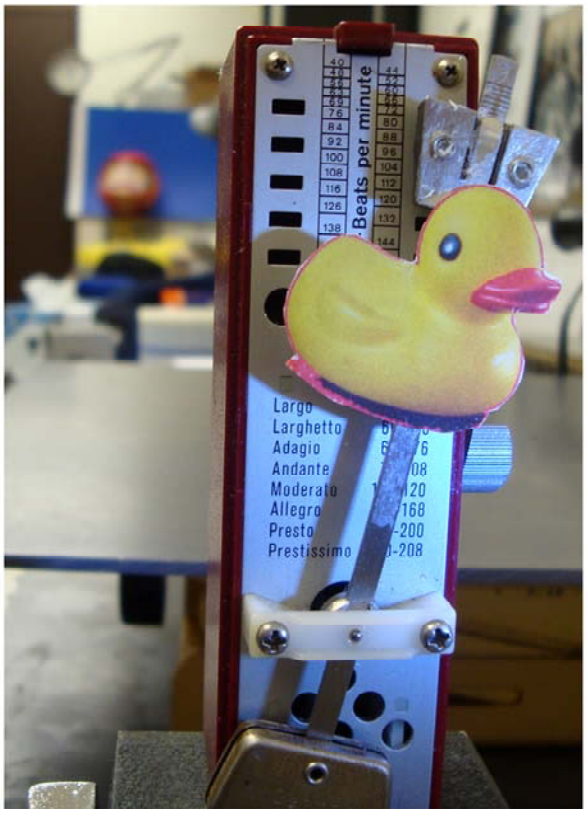


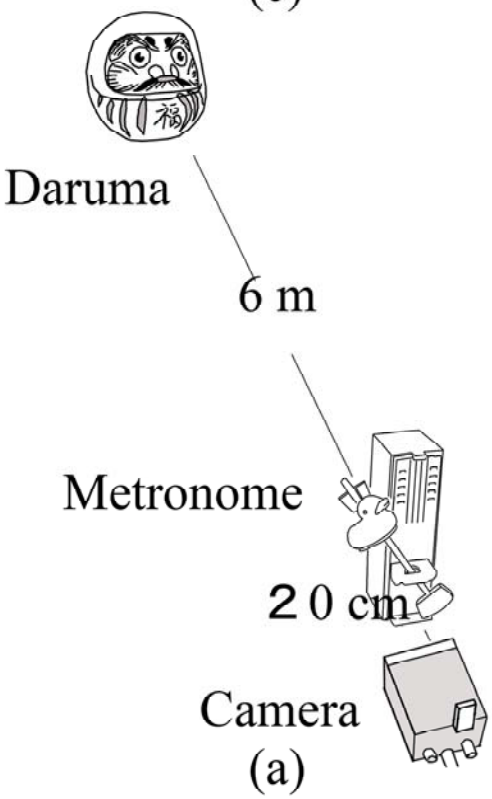
Fig. 1 Comparison between a conventional video camera and the Omni-focus Video Camera. (a) Conventional camera. (b) Omni-focus Video Camera.

In order to demonstrate that the Omni-focus Video Camera can record moving objects, a toy rubber duck fastened to the pendulum of a metronome was used as the moving target. The metronome was placed in the near distance and a Daruma doll was placed at a far distance. The geometry of the objects is shown in Fig. 2a. Sample frames from the Omni-focus Video Camera output are shown in Fig. 2b. Crisp and clear images were obtained throughout the object field. For the sake of comparison, the same scene was taken by an ordinary color video camera focused in the near distance. This video camera image is shown in Fig. 2c. While the details of the Daruma doll taken by the ordinary color video camera are almost unrecognizable, the images taken by the Omni-focus Video Camera clearly show the details of the Daruma doll without additional noise or seams between the near and far images.

(b)


Beats per minute
Largo
Larghetto
Adagio
Andante
Moderato
Allegro
Presto
Prestissimo

(c)


Daruma
6 m
Metronome
20 cm
Camera

(a)

Figure 2 Images from the Omni-focus Video Camera. (a) Geometry of the moving target. (b) Sample frames from the Omni-focus Video Camera output. (c) Image of the same scene from an ordinary color video camera

Fig. 3 demonstrates the extremely high resolution of the Omni-focus Video Camera. It shows the result of a photograph of two sewing needles placed about 1.2 meters apart. The front needle is placed at 13 cm in front of the camera. The eye of the back needle is viewed through the eye of the front needle. The images of both needles are in focus and both needles are clearly photographed.

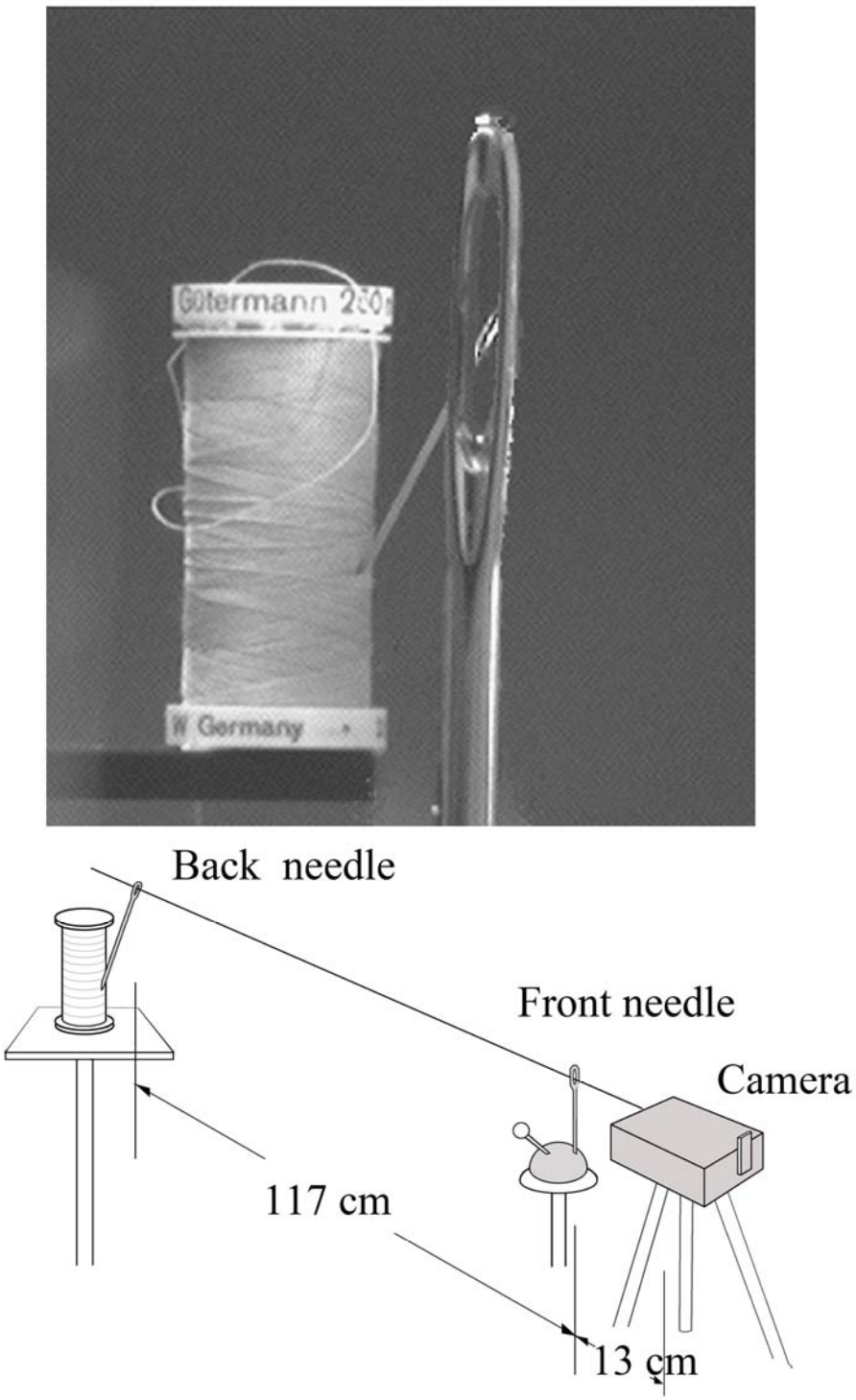


Figure 3 Photographs illustrating the high resolution of the Omni-focus Video Camera. The eye of one sewing needle is taken through the eye of another needle located 1.2 m in front.

Principle of operation.

The Omni-focus Video Camera takes videos that are everywhere in focus. Fig. 4 shows the block diagram of the principle of operation. The Omni-focus Video Camera combines an array of color video cameras each focused at a different distance as shown in the lower section of the figure, with a unique distance mapping camera (Divcam) shown in the upper section of the figure, which provides real-time distance information for every pixel in the scene. A pixel selection utility shown in the lower right section uses the distance information to select individual pixels from the multiple video outputs in order to generate the final single video display that is everywhere in focus. The present prototype has only two color video cameras to prove the concept, but with an increase in the number of color video cameras, the quality of the image is further improved.

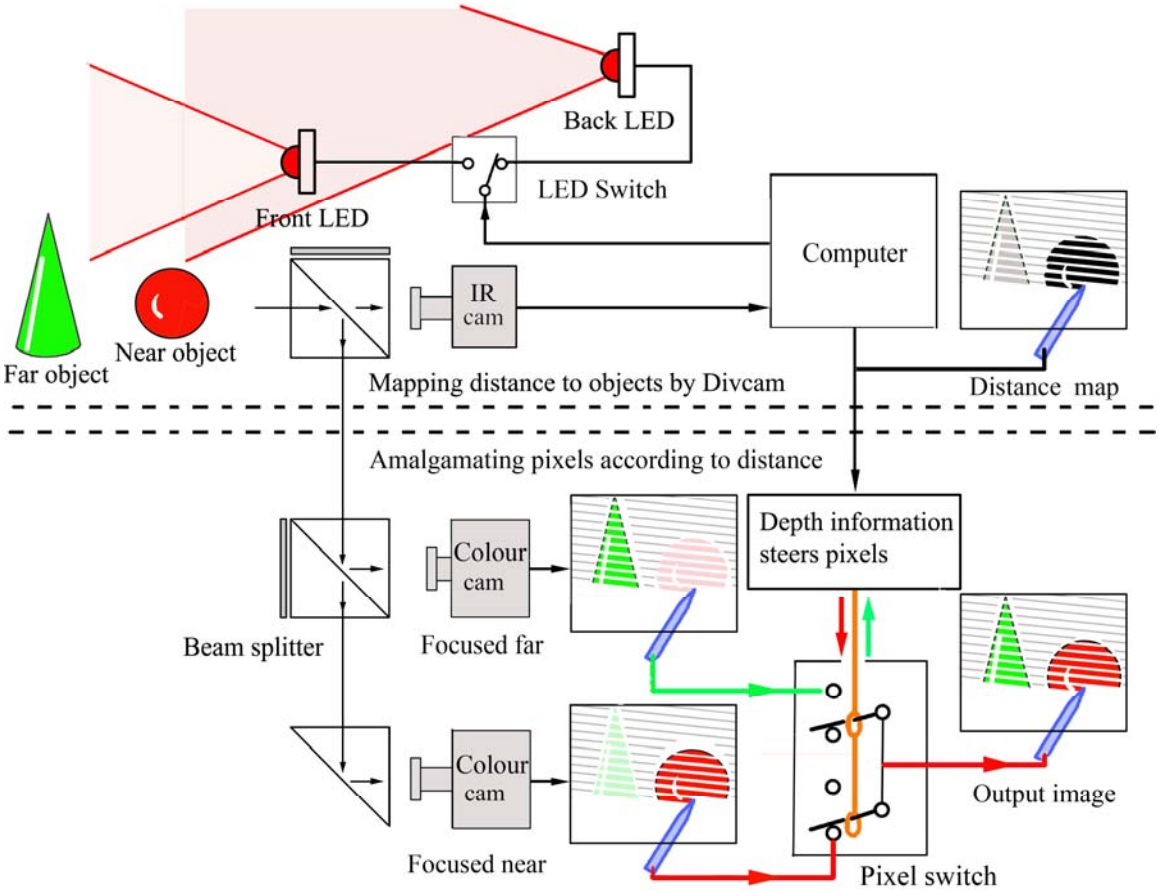


Figure 4 Principle of operation of the Omni-focus Video Camera.

Conclusion

This video camera is the first of its kind. The Omni-focus Video Camera is able to focus any object, near or far, with high image quality and without the cameraman physically having to move the camera optics in order to focus. The power of resolution of the image is limited only by the size of a pixel of the video camera. Even fingerprints in the image are recognizable.

Special features of the camera include simplicity, compactness, ruggedness, light weight, portability, high resolution, real-time operation, and low cost. Potential applications of such a video camera include TV studio cameras, home entertainment video cameras, robotic vision, and virtual vision.