Improvement of Recorded Video Quality using Auto Exposure Control (AEC) system

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Abstract

In a video camera, the Auto Exposure Control (AEC) system chooses the appropriate aperture size, gain setting, and exposure duration to match the brightness of the scene. Although there are approaches such as automatic white balance and automatic exposure employing CMOS (Complementary metal oxide semiconductor) technology, clever mechanisms to quickly assess the proper exposure when users modify the scene are lacking. When some portions of the captured video frame are overexposed or underexposed, the situation gets more acute. Robust AEC method to real-time video capturing is part of the proposed system. This comprises of a well-designed control flow as well as some heuristic methods for measuring scene brightness and adjusting exposure. The system adaptively picks appropriate sensor operational modes to achieve a more accurate estimate of scene brightness. The auto exposure system also incorporates devices to detect moving objects and fluorescent light flicker. The robust AEC system performs well under a variety of settings and aids in the improvement of recorded video quality.

1. Introduction

Although video technology was first created for cathode ray tube (CRT) television sets, various additional technologies for video display devices have since been developed. An Ampex research team lead by Charles Ginsburg developed the first workable video tape recorder (VTR).

Frame rate, or the number of still images taken per unit of video time, ranges from six or eight frames per second (frame/s) for ancient mechanical cameras to 120 or more frames per second (frame/s) for new professional cameras.

PAL (Europe, Asia, Australia, and so on) and SECAM (France, Russia, portions of Africa, and so on) standards require 25 frames per second, whereas NTSC (USA, Canada, Japan, and so on) standards specify 29.97 frames per second.

Interlaced or progressive video can be used. Interlacing was devised to eliminate flicker in early mechanical and CRT video displays without increasing the number of full frames per second, which would have necessitated losing visual resolution to stay within the constraints of a restricted bandwidth.

When an image capture device acquires fields one at a time rather than dividing up a complete frame after it is captured, the frame rate for motion is effectively doubled, resulting in smoother, more life-like reproduction (albeit with halved detail) of rapidly moving parts of the image when viewed on an interlaced CRT display, but the display of such a signal on a progressive scan device is problematic. The interlaced formats include NTSC, PAL, and SECAM.

2. Literature Survey

Presented a nonlinear technique for getting a solution to the pose and velocity computation issue that extends the usual line reprojection error. The design matrix in the normal equations is exceedingly sparse and patterned, according to a close examination. Based on bundle-adjustment-like sparse inversion, we offer a block wise solution approach. This makes nonlinear optimization quick and stable numerically. Real-world data is used to validate the approach.

An integrated MPEG video and audio recording software system with a system-on-a-chip (SoC) architecture is presented in this research. Auto exposure and auto white balance may be properly predicted and modified by completely leveraging the information received from video compression. The system incorporates bit rate management and data buffering techniques to solve the challenges of real-time streaming to storage devices.

An auto-exposure technique is presented in this study, which uses a mapping from the brightness histograms of five sub-areas in the picture to an exposure value. The mapping is carried out via a neural network. The mean, variance, minimum, and maximum brightness for each sub-area are calculated using the histogram in that sub-area. To include temporal variations in brightness into the network, the same spatial information is calculated for prior frames.

The Additive System of Picture Exposure (APEX) allows for the logarithmic expression of numerous elements involved in photographic exposure. Calculating the "appropriate exposure" for a specific circumstance may be done manually using simply addition in this manner. Despite the fact that the significance of this has waned since the system's inception, the method is still commonly employed in technical work connected to photography exposure, particularly the quantity "exposure value" (EV). This page discusses the APEX technology and provides some warnings about common APEX use anomalies.

Automatic focus, automatic exposure (AE) determination, and auto-white balance are three of the major jobs in the picture capture data flow of consumer digital cameras. Auto-focus is implemented using maximum contrast, ranging, or sonar; white balance is achieved using color gamut determinations and "gray value estimations," and auto-exposure is implemented using scene assessments. We assess the system consequences of executing one of these tasks, namely auto-exposure on a digital camera embedded system.

3. Methodology

A robust auto exposure control (AEC) solution to real-time video recording has been presented. A well-designed control flow, as well as certain heuristic rules for scene brightness assessment and exposure modification, are included in the suggested system. The system adaptively picks appropriate sensor operational modes to achieve a more accurate estimate of scene brightness.

The suggested auto exposure system also incorporates systems to detect moving objects and fluorescent light flicker. The suggested AEC system has an excellent performance and helps to enhance the recorded video quality, according to the experimental findings.

Electronically capturing, recording, processing, storing, sending, and recreating a sequence of still pictures depicting scenes in motion is what video is all about. The picture sequence's "natural" frame rate is fixed throughout the capturing procedure.

Moving picture sequences can be taken at a rate that differs from the presentation rate; when collecting video from a web camera, we use the buffer storage to store the video from the output. We get the specified data from the buffer and provide it to the Frame grabber.

Two methods for computing the picture backdrop are proposed in this paper. In addition, several operators are included to increase and equalize the contrast in grey level photographs with inadequate illumination. Contrast operators, like Weber's law, are based on the logarithm function. The logarithm function is used to avoid sudden illumination shifts.

Also offered are two approximations for computing the background in processed photos. The first solution employs a block analysis, whereas the second employs an opening by reconstruction, which has the following properties: a) it goes through regional minima, and b) it integrates picture components without significantly altering other structures.

- **Advantages**
- Obtain improved output video from the recording process itself.
- Developing as a program to apply the method that is currently present in camera technology.
- In the future, it will be simple to edit.

4. Result and discussion

The goal of the system visualisation was to detect any system flaws. After the system's management was accepted, the system was installed in the company, initially running in parallel with the old manual system. The system was tested with live data and found to be errorfree and user-friendly. When the system did the first design, implementation is the process of transforming a new or changed system design into an operational one; a demonstration of the functional system was delivered to the end user. By providing various combinations of test data, this technique is used to check and discover any logical problems with the system's operation. The system was introduced once it had been approved by both the end user and management. A product software implementation technique is a step-by-step guide for getting users and/or organisations up and running with a particular software product.

Fig.1 Frame Grabber Technique Result

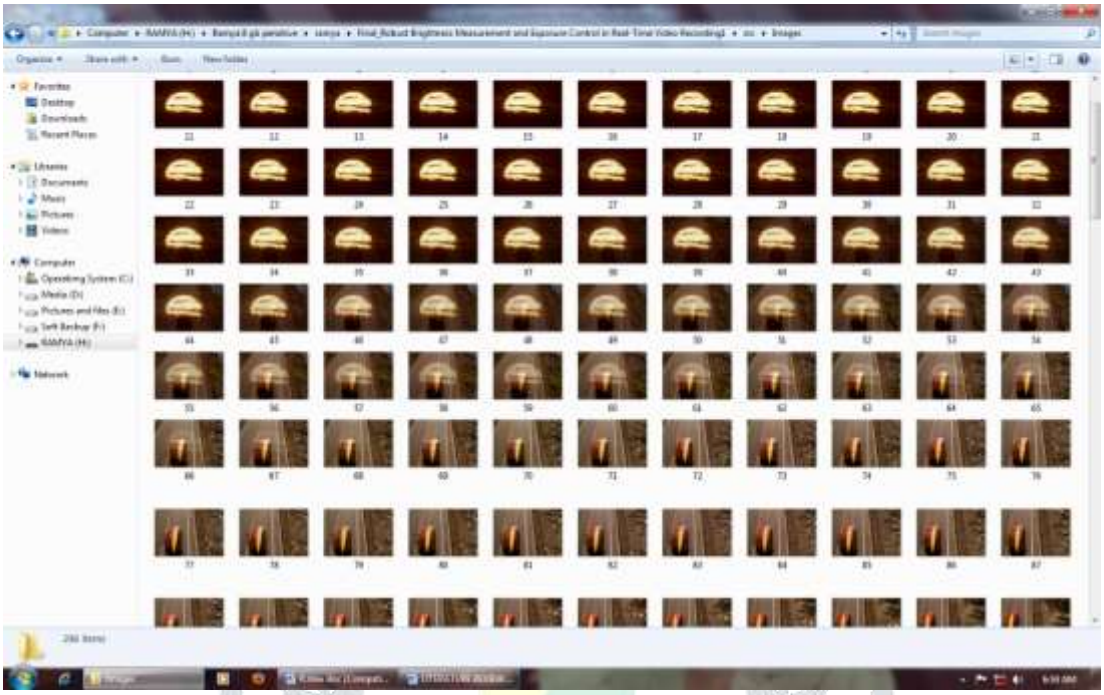

Fig. 2 Playing the original video

Fig. 3 Playing the Enhanced video

5. Conclusion

For a real-time video recording system, the video quality is heavily dependent on the accuracy of scene brightness measurement as well as the speed of exposure correction. A robust AEC system has been presented, which has more precise scene brightness estimates and accomplishes high speed exposure adjustment. Brightness measurement accuracy has been greatly enhanced by adaptively choosing the sensor's subsampling modes and employing histogram analysis to further increase brightness measurement accuracy. The speed and precision of exposure adjustment have been increased as a result of a more precise assessment of scene brightness.

References

1. Ait-Aider.O, Bartoli.A, and Andreff.N.(2007) ‘Kinematics from lines in a single rolling shutter image,’ in Proc. 7th IEEE Conf. Comput. Vis. Pattern Recog., pp. 1–6.
2. Kao.W.C, Chen.S.H, Sun.T.H, Chiang.T.Y, and Lin.S.Y.(2005) ‘An integrated software architecture for real-time video and audio recording systems,’ IEEE Trans. Consum. Electron., vol. 51, no. 3, pp. 879–884.
3. Kehtarnavaz.N, Oh.H.J, Reis.S, Yoo.Y, and Talluri.R.(2002), ‘New approach to auto-white-balancing and auto-exposure for digital still cameras,’ in Proc. SPIE Conf. Sens. Camera Syst. Sci., Ind., Digit. Photography Appl. III, vol. 4669, pp. 268–276.
4. Kerr.D.A.(2007), APEX—The Additive System of Photographic Exposure.
5. Kremens.R,Sampat.N, Venkataraman.S, and Yeh.T.(1999), ‘System implications of implementing white balance on consumer digital cameras,’ in Proc. SPIE Conf. Sens., Cameras, Appl. Digit. Photography,vol. 3650, pp. 100–107.

6. Lee.H.C.(2005), Introduction to Color Imaging Science. New York: Cambridge Univ. Press.
7. Lee.J.S, Jung.Y.Y, Kim.B.S, and Ko.S.J. (2001), 'An advanced video camera system with robust AF, AE, and AWB control,' IEEE Trans. Consum.Electron., vol. 47, no. 3, pp. 694–966.
8. Liang.C.K, Chang.L.W, and Chen.H.H.(2008), 'Analysis and compensation of rolling shutter effect,' IEEE Trans. Image Process., vol. 17, no. 8, pp. 1323–1330.
9. Liang.J, Qin.Y, and Hong.Z.(2007), 'An auto-exposure algorithm for detecting high contrast lighting conditions,' in Proc. 7th IEEE Int. Conf. ASIC, pp. 725–728.
10. Nilsson.M, Weerasinghe.C, Lichman.S, Shi.Y, and Kharitonenko.I.(2003), 'Design and implementation of a CMOS sensor based video camera incorporating a combined AWB/AEC module,' in Proc. IEEE Int. Conf. Acoust., Speech, Signal Process., vol. 2, pp. 52–56.