Efficient Video Streaming for DSP

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Abstract

TMS320DM642, digital signal processor (DSP), can be very efficient in video encoding if the system is carefully implemented. Therefore, this project aims at designing an optimized and efficient H.264 video encoder on the DSP to minimize the adverse effect of the limitation of the DSP so that CIF video can be streamed around 30 fps.

Some modules in previous year project were adapted and were improved its efficiency by taking advantages of DSP and various approaches. Meanwhile, the video signal input and network module connecting client was implemented on DSP. There is a client system built on PC to receive and play the received video. The detail structure of overall system and encoder can be found in Figure 1. and 2.

Finally, a system comprised of a DSP video encoder and a PC client is implemented. The encoder can stream CIF video captured by an attached camera to the client through internet. The client can play the received video in real-time fashion at a high frame rate.

Figure 1. The hardware system block diagram
Optimization of the encoder system is the main focus of this project. The original encoder is only capable to provide around 7 frames per second for CIF size video. This low frame rate causes unpleasant feeling for viewers. Therefore, it is necessary to boost the frame rate in order to present a smooth video to users. Optimization is one of the possible and efficient ways to enhance the encoding efficient and frame rate. The following is the techniques needed to boost the system performance:

- Memory access optimization
- Looping optimization
- Branching optimization
- Early termination
- Packed data processing
- Data structure

Modules used above techniques to enhance their efficiency:

- Inter-prediction
- DCT and Quantization and their inverse operation, and Run-Level coding
- Deblocking filter
- Entropy coding
Results

From the above diagrams, we can see the quality (in Figure 4.) and number of bits generated (in Figure 5.) of the video remains almost the same as the original encoder. On the other hand, the frame rate of video increases significantly from 7 fps to 30 fps, and the comparison on various modules between original and optimized encoder is shown in Figure 3. The time spent on each module is reduced significantly.

Conclusion

To conclude, this project is successful and reaches the goal. The encoder system is so efficient that a higher frame rate, high quality and reasonable bitrate is achieved to support real-time CIF video streaming.