CompE 565: Multimedia Communication Systems
Project 4: Video Codec
Due Date: Sunday, 05/01/2022 at 11:59 pm

Learning Goal: Develop a basic MPEG Video encoder and decoder to understand the working principles of video coding.

Project Description: This project is an integration of the concepts implemented in Home Work Assignments #2 and 3.

Problem Statement: Implement an MPEG like encoder and decoder for the 5 frames of the video sequence given in HW3, using the frame numbers and other specifications provided in HW3. Use a constant Quantizer value of 28 for every frame. A simplified block diagram of the encoder is given in Figure 1.
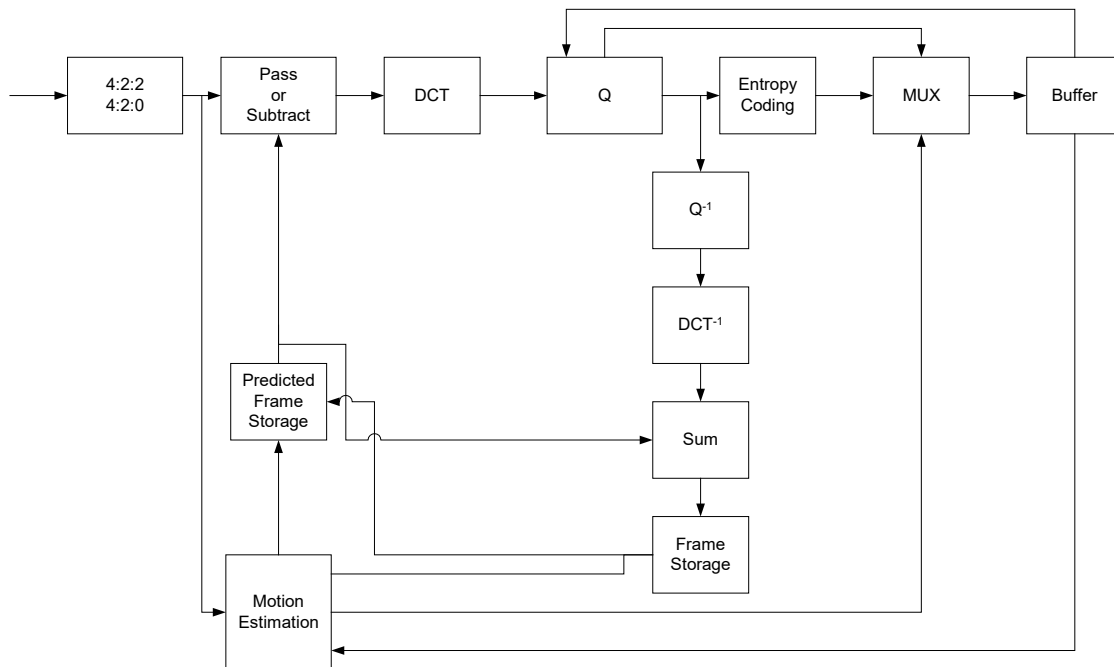

Figure 1: MPEG encoder diagram (ignore the Entropy coding, MUX, and buffer)

Although not shown in Figure 1, motion vectors and Q parameters will need to be transmitted to the decoder. If the motion estimation results in a motion vector of (0, 0) and the prediction error (SAD) is less than 128, the block will not be transmitted. The decoder should be signaled to use the block from the reference image for this block.

Note: we are not implementing the Entropy coding, multiplexing and buffer control.

Encoder profile: Frame Size: 174 x 144 (show results for only the 5 frames specified in HW3), Format: 4:2:0, use a GOP of 5 frames (I + 4 P, with no B-frames), Macroblock size: 16 x 16 and Block Size: 8 x 8 pixels.

Do not transmit MBs in which MV = {0.0} and prediction error is less than 128.

The following data structure will be communicated between the encoder and decoder for each frame coded and transmitted.

The quantization parameters should be chosen to fit the quantized values into one byte regardless of the AC or DC coefficient.

Image Data – **this is only a suggestion; you are free to use your own logic**

Image Start: (1 bytes code = 0xEE)
      Slice Start (1 bytes code = 0xDD) % You may decide not to use slice or select the whole
                                      frame as one slice.
          Macroblock1
               (MacroBlock Type = 1 bytes   -- set to 1 for I and 0 for P macroblock and
               2 if macroblock is not transmitted)
               If (Macroblock is transmitted then
                              (Qb   = 1 Byte)
                              (MVx   = 1 Byte)
                              (MVy = 1 Byte)
                              (DC coeff and 7 AC coeff)   for top left block
                              (DC coeff and 7 AC coeff)   for top right block
                              (DC coeff and 7 AC coeff)   for bottom left block
                              (DC coeff and 7 AC coeff)   for bottom right block
          Macroblock2
          Macroblock3
          …
          …
          …
      Slice End (1 bytes code = 0xDF)
      Next Slice Start (1 bytes code = 0xDD)
          Macroblock1
          MacroBlock2
          Macroblock3
          …
          …
    …
      Image End.

Your report should include the following:
- Show the difference P frames obtained after the Inverse DCT block in the figure above.
- Show the reconstructed frames.
- A thorough discussion of your implementation and the simulation results.