數字媒體技術基礎作業

郑翰浓，2101212849,信息工程學院
干皓丞，2101212850,信息工程學院

2021 年 12 月 22 日

1　摘要

本作业主题为熵编码，在 ITM 进行改进与准备。此为测试前准备报告，报告对 ITM 15 的 lencod 目录下的 biariencode.h 中的 B_BITS10 进行实验，将事前准备的 5 个测试影片进行测试，并汇整所产生的 *.bit 档案大小，最后绘制成图。

2　事前

在此制作 5 个 10 秒与 5 个 4 秒的测试影片，并转成 YUV 影像，其素材取自深圳市大学城北大校区邻近图书馆与图书馆咖啡厅一带，内容包含了图书馆咖啡厅、图书馆旁的步道、图书馆内书架陈列、图书馆旁的草皮与隐藏人物。各视频录制约 10 秒，并同时准备 4 秒的版本，最后再输出乘 YUV。
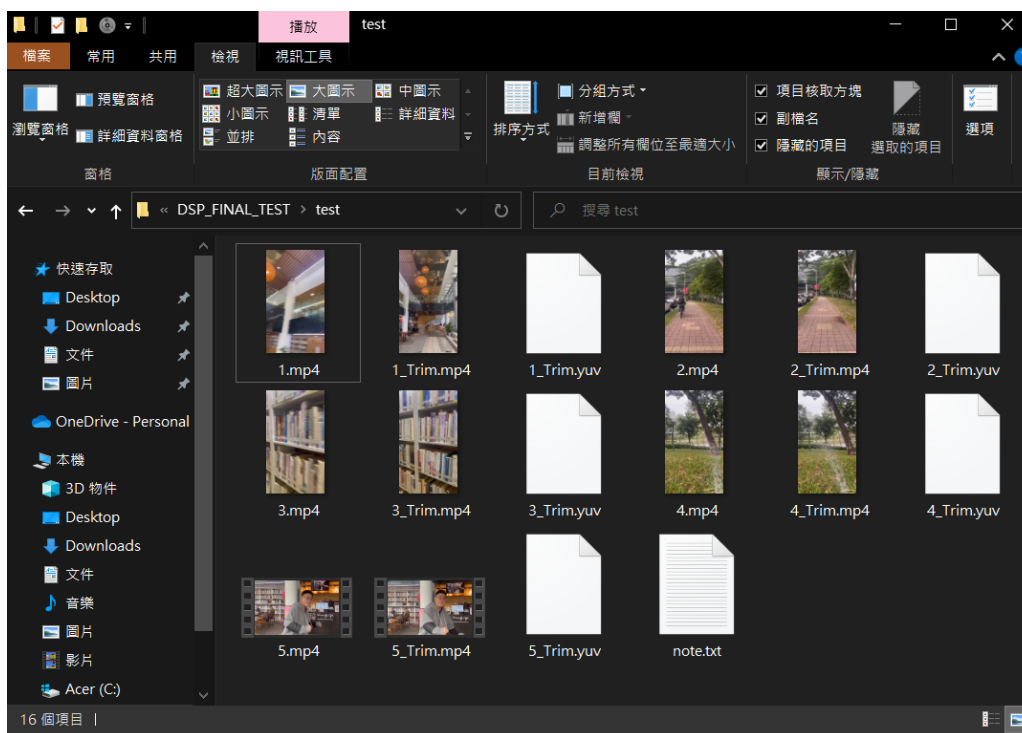

Fig. 1. 测试资料表列结果

3　指令

首先使用 FFMPEG 产生 YUV 档案，其产生过程的纪录如下。
1. 图书馆咖啡厅

```
1  (base) PS D:\USERDATA\Desktop\DSP_FINAL_TEST\test> ffmpeg -i 1_Trim.mp4 -s 320
       x240 -pix_fmt yuv420p -r 15 1_Trim.yuv
2  ffmpeg version 2021-09-22-git-447cf53774-full_build-www.gyan.dev Copyright (c)
       2000-2021 the FFmpeg developers
3    built with gcc 10.3.0 (Rev5, Built by MSYS2 project)
4    configuration: --enable-gpl --enable-version3 --enable-static --disable-
         w32threads --disable-autodetect --enable-fontconfig --enable-iconv --enable
         -gnutls --enable-libxml2 --enable-gmp --enable-lzma --enable-libsnappy --
         enable-zlib --enable-librist --enable-libsrt --enable-libssh --enable-
         libzmq --enable-avisynth --enable-libbluray --enable-libcaca --enable-sdl2
         --enable-libdav1d --enable-libzvbi --enable-librav1e --enable-libsvtav1 --
         enable-libwebp --enable-libx264 --enable-libx265 --enable-libxvid --enable-
         libaom --enable-libopenjpeg --enable-libvpx --enable-libass --enable-frei0r
          --enable-libfreetype --enable-libfribidi --enable-libvidstab --enable-
         libvmaf --enable-libzimg --enable-amf --enable-cuda-llvm --enable-cuvid --
         enable-ffnvcodec --enable-nvdec --enable-nvenc --enable-d3d11va --enable-
         dxva2 --enable-libmfx --enable-libglslang --enable-vulkan --enable-opencl
         --enable-libcdio --enable-libgme --enable-libmodplug --enable-libopenmpt --
         enable-libopencore-amrwb --enable-libmp3lame --enable-libshine --enable-
         libtheora --enable-libtwolame --enable-libvo-amrwbenc --enable-libilbc --
         enable-libgsm --enable-libopencore-amrnb --enable-libopus --enable-libspeex
          --enable-libvorbis --enable-ladspa --enable-libbs2b --enable-libflite --
         enable-libmysofa --enable-librubberband --enable-libsoxr --enable-
         chromaprint
5    libavutil      57.  6.100 / 57.  6.100
6    libavcodec     59.  9.100 / 59.  9.100
7    libavformat    59.  5.100 / 59.  5.100
8    libavdevice    59.  0.101 / 59.  0.101
9    libavfilter     8.  9.100 /  8.  9.100
10   libswscale      6.  1.100 /  6.  1.100
11   libswresample   4.  0.100 /  4.  0.100
12   libpostproc    56.  0.100 / 56.  0.100
13 Input #0, mov,mp4,m4a,3gp,3g2,mj2, from '1_Trim.mp4':
14   Metadata:
15     major_brand     : mp42
16     minor_version   : 0
17     compatible_brands: mp41isom
18     creation_time   : 2021-12-14T01:47:50.000000Z
19   Duration: 00:00:04.19, start: 0.000000, bitrate: 3808 kb/s
20   Stream #0:0[0x1](und): Video: h264 (Main) (avc1 / 0x31637661), yuv420p, 544
       x960 [SAR 1:1 DAR 17:30], 3700 kb/s, 30 fps, 30 tbr, 30k tbn (default)
21     Metadata:
22       creation_time   : 2021-12-18T06:23:36.000000Z
23       handler_name    : VideoHandler
24       vendor_id       : [0][0][0][0]
25       encoder         : AVC Coding
```

```
26    Stream #0:1[0x2](und): Audio: aac (LC) (mp4a / 0x6134706D), 48000 Hz, stereo,
         fltp, 180 kb/s (default)
27      Metadata:
28        creation_time   : 2021-12-18T06:23:36.000000Z
29        handler_name    : SoundHandler
30        vendor_id       : [0][0][0][0]
31  Stream mapping:
32    Stream #0:0 -> #0:0 (h264 (native) -> rawvideo (native))
33  Press [q] to stop, [?] for help
34  Output #0, rawvideo, to '1_Trim.yuv':
35    Metadata:
36      major_brand     : mp42
37      minor_version   : 0
38      compatible_brands: mp41isom
39      encoder         : Lavf59.5.100
40    Stream #0:0(und): Video: rawvideo (I420 / 0x30323449), yuv420p(tv, progressive
         ), 320x240 [SAR 17:40 DAR 17:30], q=2-31, 13824 kb/s, 15 fps, 15 tbn (
         default)
41      Metadata:
42        creation_time   : 2021-12-18T06:23:36.000000Z
43        handler_name    : VideoHandler
44        vendor_id       : [0][0][0][0]
45        encoder         : Lavc59.9.100 rawvideo
46  frame=    63 fps=0.0 q=-0.0 Lsize=    7088kB time=00:00:04.20 bitrate=13824.0
       kbits/s dup=0 drop=60 speed=8.21x
47  video:7088kB audio:0kB subtitle:0kB other streams:0kB global headers:0kB muxing
       overhead: 0.000000%
48  (base) PS D:\USERDATA\Desktop\DSP_FINAL_TEST\test>
```

2. 图书馆旁的步道

```
1  (base) PS D:\USERDATA\Desktop\DSP_FINAL_TEST\test> ffmpeg -i 2_Trim.mp4 -s 320
      x240 -pix_fmt yuv420p -r 15 2_Trim.yuv
2  ffmpeg version 2021-09-22-git-447cf53774-full_build-www.gyan.dev Copyright (c)
      2000-2021 the FFmpeg developers
3    built with gcc 10.3.0 (Rev5, Built by MSYS2 project)
4    configuration: --enable-gpl --enable-version3 --enable-static --disable-
        w32threads --disable-autodetect --enable-fontconfig --enable-iconv --enable
        -gnutls --enable-libxml2 --enable-gmp --enable-lzma --enable-libsnappy --
        enable-zlib --enable-librist --enable-libsrt --enable-libssh --enable-
        libzmq --enable-avisynth --enable-libbluray --enable-libcaca --enable-sdl2
        --enable-libdav1d --enable-libzvbi --enable-librav1e --enable-libsvtav1 --
        enable-libwebp --enable-libx264 --enable-libx265 --enable-libxvid --enable-
        libaom --enable-libopenjpeg --enable-libvpx --enable-libass --enable-frei0r
         --enable-libfreetype --enable-libfribidi --enable-libvidstab --enable-
        libvmaf --enable-libzimg --enable-amf --enable-cuda-llvm --enable-cuvid --
        enable-ffnvcodec --enable-nvdec --enable-nvenc --enable-d3d11va --enable-
        dxva2 --enable-libmfx --enable-libglslang --enable-vulkan --enable-opencl
```

```
      --enable-libcdio --enable-libgme --enable-libmodplug --enable-libopenmpt --
      enable-libopencore-amrwb --enable-libmp3lame --enable-libshine --enable-
      libtheora --enable-libtwolame --enable-libvo-amrwbenc --enable-libilbc --
      enable-libgsm --enable-libopencore-amrnb --enable-libopus --enable-libspeex
       --enable-libvorbis --enable-ladspa --enable-libbs2b --enable-libflite --
      enable-libmysofa --enable-librubberband --enable-libsoxr --enable-
      chromaprint
 5  libavutil      57.  6.100 / 57.  6.100
 6  libavcodec     59.  9.100 / 59.  9.100
 7  libavformat    59.  5.100 / 59.  5.100
 8  libavdevice    59.  0.101 / 59.  0.101
 9  libavfilter     8.  9.100 /  8.  9.100
10  libswscale      6.  1.100 /  6.  1.100
11  libswresample   4.  0.100 /  4.  0.100
12  libpostproc    56.  0.100 / 56.  0.100
13 Input #0, mov,mp4,m4a,3gp,3g2,mj2, from '2_Trim.mp4':
14   Metadata:
15     major_brand     : mp42
16     minor_version   : 0
17     compatible_brands: mp41isom
18     creation_time   : 2021-12-14T01:47:20.000000Z
19   Duration: 00:00:04.98, start: 0.000000, bitrate: 11162 kb/s
20   Stream #0:0[0x1](und): Video: h264 (Main) (avc1 / 0x31637661), yuv420p, 720
       x1280 [SAR 1:1 DAR 9:16], 11302 kb/s, 30 fps, 30 tbr, 30k tbn (default)
21     Metadata:
22       creation_time   : 2021-12-18T06:24:19.000000Z
23       handler_name    : VideoHandler
24       vendor_id       : [0][0][0][0]
25       encoder         : AVC Coding
26   Stream #0:1[0x2](und): Audio: aac (LC) (mp4a / 0x6134706D), 48000 Hz, stereo,
       fltp, 180 kb/s (default)
27     Metadata:
28       creation_time   : 2021-12-18T06:24:19.000000Z
29       handler_name    : SoundHandler
30       vendor_id       : [0][0][0][0]
31 Stream mapping:
32   Stream #0:0 -> #0:0 (h264 (native) -> rawvideo (native))
33 Press [q] to stop, [?] for help
34 Output #0, rawvideo, to '2_Trim.yuv':
35   Metadata:
36     major_brand     : mp42
37     minor_version   : 0
38     compatible_brands: mp41isom
39     encoder         : Lavf59.5.100
40   Stream #0:0(und): Video: rawvideo (I420 / 0x30323449), yuv420p(tv, progressive
       ), 320x240 [SAR 27:64 DAR 9:16], q=2-31, 13824 kb/s, 15 fps, 15 tbn (
       default)
```

```
41      Metadata :
42        creation_time    : 2021-12-18T06:24:19.000000Z
43        handler_name     : VideoHandler
44        vendor_id        : [0][0][0][0]
45        encoder          : Lavc59.9.100 rawvideo
46  frame=    75 fps=0.0 q=-0.0 Lsize=      8438kB time=00:00:05.00 bitrate=13824.0
        kbits/s dup=1 drop=71 speed= 5.6x
47  video:8438kB audio:0kB subtitle:0kB other streams:0kB global headers:0kB muxing
        overhead: 0.000000%
48  (base) PS D:\USERDATA\Desktop\DSP_FINAL_TEST\test >
```

3. 图书馆内书架陈列

```
1   (base) PS D:\USERDATA\Desktop\DSP_FINAL_TEST\test > ffmpeg -i 3_Trim.mp4 -s 320
        x240 -pix_fmt yuv420p -r 15 3_Trim.yuv
2   ffmpeg version 2021-09-22-git-447cf53774-full_build-www.gyan.dev Copyright (c)
        2000-2021 the FFmpeg developers
3     built with gcc 10.3.0 (Rev5, Built by MSYS2 project)
4     configuration: --enable-gpl --enable-version3 --enable-static --disable-
        w32threads --disable-autodetect --enable-fontconfig --enable-iconv --enable
        -gnutls --enable-libxml2 --enable-gmp --enable-lzma --enable-libsnappy --
        enable-zlib --enable-librist --enable-libsrt --enable-libssh --enable-
        libzmq --enable-avisynth --enable-libbluray --enable-libcaca --enable-sdl2
        --enable-libdav1d --enable-libzvbi --enable-librav1e --enable-libsvtav1 --
        enable-libwebp --enable-libx264 --enable-libx265 --enable-libxvid --enable-
        libaom --enable-libopenjpeg --enable-libvpx --enable-libass --enable-frei0r
         --enable-libfreetype --enable-libfribidi --enable-libvidstab --enable-
        libvmaf --enable-libzimg --enable-amf --enable-cuda-llvm --enable-cuvid --
        enable-ffnvcodec --enable-nvdec --enable-nvenc --enable-d3d11va --enable-
        dxva2 --enable-libmfx --enable-libglslang --enable-vulkan --enable-opencl
        --enable-libcdio --enable-libgme --enable-libmodplug --enable-libopenmpt --
        enable-libopencore-amrwb --enable-libmp3lame --enable-libshine --enable-
        libtheora --enable-libtwolame --enable-libvo-amrwbenc --enable-libilbc --
        enable-libgsm --enable-libopencore-amrnb --enable-libopus --enable-libspeex
         --enable-libvorbis --enable-ladspa --enable-libbs2b --enable-libflite --
        enable-libmysofa --enable-librubberband --enable-libsoxr --enable-
        chromaprint
5     libavutil      57.  6.100 / 57.  6.100
6     libavcodec     59.  9.100 / 59.  9.100
7     libavformat    59.  5.100 / 59.  5.100
8     libavdevice    59.  0.101 / 59.  0.101
9     libavfilter     8.  9.100 /  8.  9.100
10    libswscale      6.  1.100 /  6.  1.100
11    libswresample   4.  0.100 /  4.  0.100
12    libpostproc    56.  0.100 / 56.  0.100
13  Input #0, mov,mp4,m4a,3gp,3g2,mj2, from '3_Trim.mp4':
14    Metadata:
15      major_brand      : mp42
```

```
16       minor_version  : 0
17       compatible_brands: mp41isom
18       creation_time   : 2021-12-14T01:47:41.000000Z
19     Duration: 00:00:04.89, start: 0.000000, bitrate: 3705 kb/s
20     Stream #0:0[0x1](und): Video: h264 (Main) (avc1 / 0x31637661), yuv420p, 544
          x960 [SAR 1:1 DAR 17:30], 3643 kb/s, 30 fps, 30 tbr, 30k tbn (default)
21       Metadata:
22         creation_time   : 2021-12-18T06:24:54.000000Z
23         handler_name    : VideoHandler
24         vendor_id       : [0][0][0][0]
25         encoder         : AVC Coding
26     Stream #0:1[0x2](und): Audio: aac (LC) (mp4a / 0x6134706D), 48000 Hz, stereo,
          fltp, 176 kb/s (default)
27       Metadata:
28         creation_time   : 2021-12-18T06:24:54.000000Z
29         handler_name    : SoundHandler
30         vendor_id       : [0][0][0][0]
31  Stream mapping:
32     Stream #0:0 -> #0:0 (h264 (native) -> rawvideo (native))
33  Press [q] to stop, [?] for help
34  Output #0, rawvideo, to '3_Trim.yuv':
35     Metadata:
36       major_brand     : mp42
37       minor_version   : 0
38       compatible_brands: mp41isom
39       encoder         : Lavf59.5.100
40     Stream #0:0(und): Video: rawvideo (I420 / 0x30323449), yuv420p(tv, progressive
          ), 320x240 [SAR 17:40 DAR 17:30], q=2-31, 13824 kb/s, 15 fps, 15 tbn (
          default)
41       Metadata:
42         creation_time   : 2021-12-18T06:24:54.000000Z
43         handler_name    : VideoHandler
44         vendor_id       : [0][0][0][0]
45         encoder         : Lavc59.9.100 rawvideo
46  frame=    74 fps=0.0 q=-0.0 Lsize=     8325kB time=00:00:04.93 bitrate=13824.0
       kbits/s dup=1 drop=69 speed=12.2x
47  video:8325kB audio:0kB subtitle:0kB other streams:0kB global headers:0kB muxing
       overhead: 0.000000%
48  (base) PS D:\USERDATA\Desktop\DSP_FINAL_TEST\test>
```

4. 图书馆旁的草皮

```
1  (base) PS D:\USERDATA\Desktop\DSP_FINAL_TEST\test> ffmpeg -i 4_Trim.mp4 -s 320
      x240 -pix_fmt yuv420p -r 15 4_Trim.yuv
2  ffmpeg version 2021-09-22-git-447cf53774-full_build-www.gyan.dev Copyright (c)
      2000-2021 the FFmpeg developers
3    built with gcc 10.3.0 (Rev5, Built by MSYS2 project)
4    configuration: --enable-gpl --enable-version3 --enable-static --disable-
```

```
       w32threads --disable-autodetect --enable-fontconfig --enable-iconv --enable
       -gnutls --enable-libxml2 --enable-gmp --enable-lzma --enable-libsnappy --
       enable-zlib --enable-librist --enable-libsrt --enable-libssh --enable-
       libzmq --enable-avisynth --enable-libbluray --enable-libcaca --enable-sdl2
       --enable-libdav1d --enable-libzvbi --enable-librav1e --enable-libsvtav1 --
       enable-libwebp --enable-libx264 --enable-libx265 --enable-libxvid --enable-
       libaom --enable-libopenjpeg --enable-libvpx --enable-libass --enable-frei0r
        --enable-libfreetype --enable-libfribidi --enable-libvidstab --enable-
       libvmaf --enable-libzimg --enable-amf --enable-cuda-llvm --enable-cuvid --
       enable-ffnvcodec --enable-nvdec --enable-nvenc --enable-d3d11va --enable-
       dxva2 --enable-libmfx --enable-libglslang --enable-vulkan --enable-opencl
       --enable-libcdio --enable-libgme --enable-libmodplug --enable-libopenmpt --
       enable-libopencore-amrwb --enable-libmp3lame --enable-libshine --enable-
       libtheora --enable-libtwolame --enable-libvo-amrwbenc --enable-libilbc --
       enable-libgsm --enable-libopencore-amrnb --enable-libopus --enable-libspeex
        --enable-libvorbis --enable-ladspa --enable-libbs2b --enable-libflite --
       enable-libmysofa --enable-librubberband --enable-libsoxr --enable-
       chromaprint
 5    libavutil      57.  6.100 / 57.   6.100
 6    libavcodec     59.  9.100 / 59.   9.100
 7    libavformat    59.  5.100 / 59.   5.100
 8    libavdevice    59.  0.101 / 59.   0.101
 9    libavfilter     8.  9.100 /  8.   9.100
10    libswscale      6.  1.100 /  6.   1.100
11    libswresample   4.  0.100 /  4.   0.100
12    libpostproc    56.  0.100 / 56.   0.100
13  Input #0, mov,mp4,m4a,3gp,3g2,mj2, from '4_Trim.mp4':
14    Metadata:
15      major_brand     : mp42
16      minor_version   : 0
17      compatible_brands: mp41isom
18      creation_time   : 2021-12-14T01:47:31.000000Z
19    Duration: 00:00:04.87, start: 0.000000, bitrate: 14394 kb/s
20    Stream #0:0[0x1](und): Video: h264 (Main) (avc1 / 0x31637661), yuv420p, 720
         x1280 [SAR 1:1 DAR 9:16], 14600 kb/s, 30 fps, 30 tbr, 30k tbn (default)
21      Metadata:
22        creation_time   : 2021-12-18T06:26:14.000000Z
23        handler_name    : VideoHandler
24        vendor_id       : [0][0][0][0]
25        encoder         : AVC Coding
26    Stream #0:1[0x2](und): Audio: aac (LC) (mp4a / 0x6134706D), 48000 Hz, stereo,
         fltp, 198 kb/s (default)
27      Metadata:
28        creation_time   : 2021-12-18T06:26:14.000000Z
29        handler_name    : SoundHandler
30        vendor_id       : [0][0][0][0]
31  Stream mapping:
```

```
32    Stream #0:0 -> #0:0 (h264 (native) -> rawvideo (native))
33  Press [q] to stop, [?] for help
34  Output #0, rawvideo, to '4_Trim.yuv':
35    Metadata:
36      major_brand     : mp42
37      minor_version   : 0
38      compatible_brands: mp41isom
39      encoder         : Lavf59.5.100
40    Stream #0:0(und): Video: rawvideo (I420 / 0x30323449), yuv420p(tv, progressive
        ), 320x240 [SAR 27:64 DAR 9:16], q=2-31, 13824 kb/s, 15 fps, 15 tbn (
        default)
41      Metadata:
42        creation_time   : 2021-12-18T06:26:14.000000Z
43        handler_name    : VideoHandler
44        vendor_id       : [0][0][0][0]
45        encoder         : Lavc59.9.100 rawvideo
46  frame=    74 fps=0.0 q=-0.0 Lsize=    8325kB time=00:00:04.93 bitrate=13824.0
        kbits/s dup=1 drop=69 speed=5.28x
47  video:8325kB audio:0kB subtitle:0kB other streams:0kB global headers:0kB muxing
        overhead: 0.000000%
48  (base) PS D:\USERDATA\Desktop\DSP_FINAL_TEST\test>
```

5. 隐藏人物

```
1  (base) PS D:\USERDATA\Desktop\DSP_FINAL_TEST\test> ffmpeg -i 5_Trim.mp4 -s 320
       x240 -pix_fmt yuv420p -r 15 5_Trim.yuv
2  ffmpeg version 2021-09-22-git-447cf53774-full_build-www.gyan.dev Copyright (c)
       2000-2021 the FFmpeg developers
3    built with gcc 10.3.0 (Rev5, Built by MSYS2 project)
4    configuration: --enable-gpl --enable-version3 --enable-static --disable-
        w32threads --disable-autodetect --enable-fontconfig --enable-iconv --enable
        -gnutls --enable-libxml2 --enable-gmp --enable-lzma --enable-libsnappy --
        enable-zlib --enable-librist --enable-libsrt --enable-libssh --enable-
        libzmq --enable-avisynth --enable-libbluray --enable-libcaca --enable-sdl2
        --enable-libdav1d --enable-libzvbi --enable-librav1e --enable-libsvtav1 --
        enable-libwebp --enable-libx264 --enable-libx265 --enable-libxvid --enable-
        libaom --enable-libopenjpeg --enable-libvpx --enable-libass --enable-frei0r
         --enable-libfreetype --enable-libfribidi --enable-libvidstab --enable-
        libvmaf --enable-libzimg --enable-amf --enable-cuda-llvm --enable-cuvid --
        enable-ffnvcodec --enable-nvdec --enable-nvenc --enable-d3d11va --enable-
        dxva2 --enable-libmfx --enable-libglslang --enable-vulkan --enable-opencl
        --enable-libcdio --enable-libgme --enable-libmodplug --enable-libopenmpt --
        enable-libopencore-amrwb --enable-libmp3lame --enable-libshine --enable-
        libtheora --enable-libtwolame --enable-libvo-amrwbenc --enable-libilbc --
        enable-libgsm --enable-libopencore-amrnb --enable-libopus --enable-libspeex
         --enable-libvorbis --enable-ladspa --enable-libbs2b --enable-libflite --
        enable-libmysofa --enable-librubberband --enable-libsoxr --enable-
        chromaprint
```

```
 5    libavutil        57.  6.100 / 57.  6.100
 6    libavcodec       59.  9.100 / 59.  9.100
 7    libavformat      59.  5.100 / 59.  5.100
 8    libavdevice      59.  0.101 / 59.  0.101
 9    libavfilter       8.  9.100 /  8.  9.100
10    libswscale        6.  1.100 /  6.  1.100
11    libswresample     4.  0.100 /  4.  0.100
12    libpostproc      56.  0.100 / 56.  0.100
13  Input #0, mov,mp4,m4a,3gp,3g2,mj2, from '5_Trim.mp4':
14    Metadata:
15      major_brand     : mp42
16      minor_version   : 0
17      compatible_brands: mp41isom
18      creation_time   : 2021-12-14T01:47:59.000000Z
19    Duration: 00:00:04.93, start: 0.000000, bitrate: 4755 kb/s
20    Stream #0:0[0x1](und): Video: h264 (Main) (avc1 / 0x31637661), yuv420p, 1280
        x720 [SAR 1:1 DAR 16:9], 4733 kb/s, 30 fps, 30 tbr, 30k tbn (default)
21      Metadata:
22        creation_time   : 2021-12-18T06:27:01.000000Z
23        handler_name    : VideoHandler
24        vendor_id       : [0][0][0][0]
25        encoder         : AVC Coding
26    Stream #0:1[0x2](und): Audio: aac (LC) (mp4a / 0x6134706D), 48000 Hz, stereo,
        fltp, 179 kb/s (default)
27      Metadata:
28        creation_time   : 2021-12-18T06:27:01.000000Z
29        handler_name    : SoundHandler
30        vendor_id       : [0][0][0][0]
31  Stream mapping:
32    Stream #0:0 -> #0:0 (h264 (native) -> rawvideo (native))
33  Press [q] to stop, [?] for help
34  Output #0, rawvideo, to '5_Trim.yuv':
35    Metadata:
36      major_brand     : mp42
37      minor_version   : 0
38      compatible_brands: mp41isom
39      encoder         : Lavf59.5.100
40    Stream #0:0(und): Video: rawvideo (I420 / 0x30323449), yuv420p(tv, progressive
        ), 320x240 [SAR 4:3 DAR 16:9], q=2-31, 13824 kb/s, 15 fps, 15 tbn (default)
41      Metadata:
42        creation_time   : 2021-12-18T06:27:01.000000Z
43        handler_name    : VideoHandler
44        vendor_id       : [0][0][0][0]
45        encoder         : Lavc59.9.100 rawvideo
46  frame=    74 fps=0.0 q=-0.0 Lsize=     8325kB time=00:00:04.93 bitrate=13824.0
        kbits/s dup=1 drop=70 speed=8.97x
47  video:8325kB audio:0kB subtitle:0kB other streams:0kB global headers:0kB muxing
```

```
     overhead: 0.000000%
48  (base) PS D:\USERDATA\Desktop\DSP_FINAL_TEST\test>
```

各指令记录如下：

```
1   ffmpeg -i 1_Trim.mp4 -s 320x240 -pix_fmt yuv420p -r 15 1_Trim.yuv
2
3   ffmpeg -i 2_Trim.mp4 -s 320x240 -pix_fmt yuv420p -r 15 2_Trim.yuv
4
5   ffmpeg -i 3_Trim.mp4 -s 320x240 -pix_fmt yuv420p -r 15 3_Trim.yuv
6
7   ffmpeg -i 4_Trim.mp4 -s 320x240 -pix_fmt yuv420p -r 15 4_Trim.yuv
8
9   ffmpeg -i 5_Trim.mp4 -s 320x240 -pix_fmt yuv420p -r 15 5_Trim.yuv
10
11  ffplay -video_size 320x240 -i 1_Trim.yuv
12
13  ffplay -video_size 320x240 -i 2_Trim.yuv
14
15  ffplay -video_size 320x240 -i 3_Trim.yuv
16
17  ffplay -video_size 320x240 -i 4_Trim.yuv
18
19  ffplay -video_size 320x240 -i 5_Trim.yuv
```

最后播放结果如下：
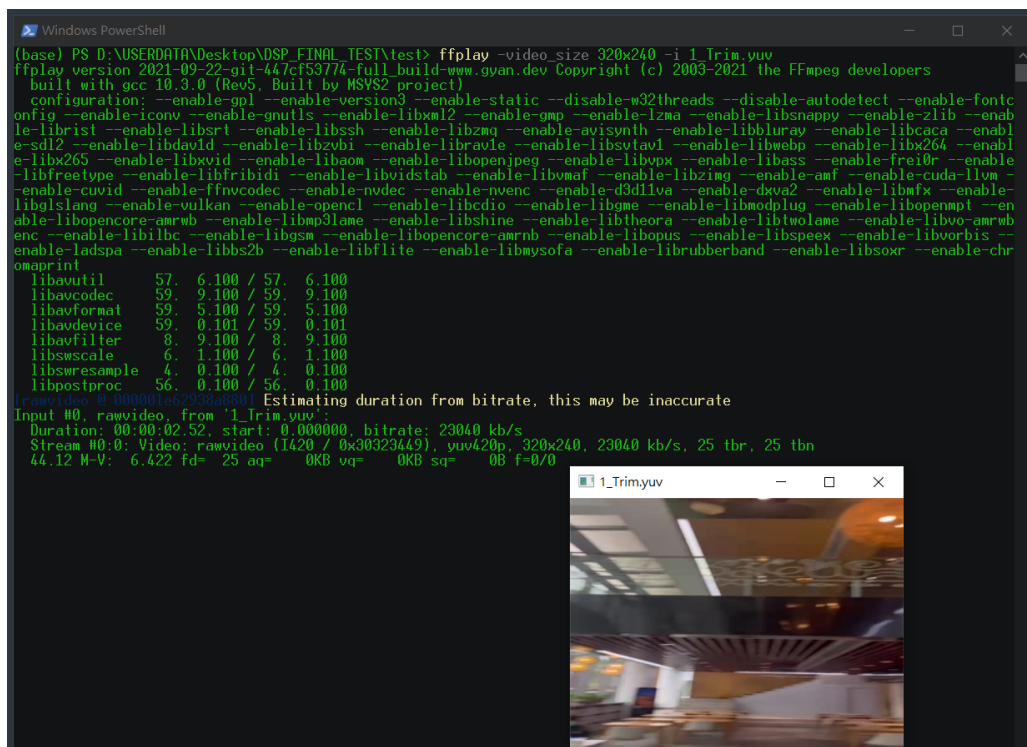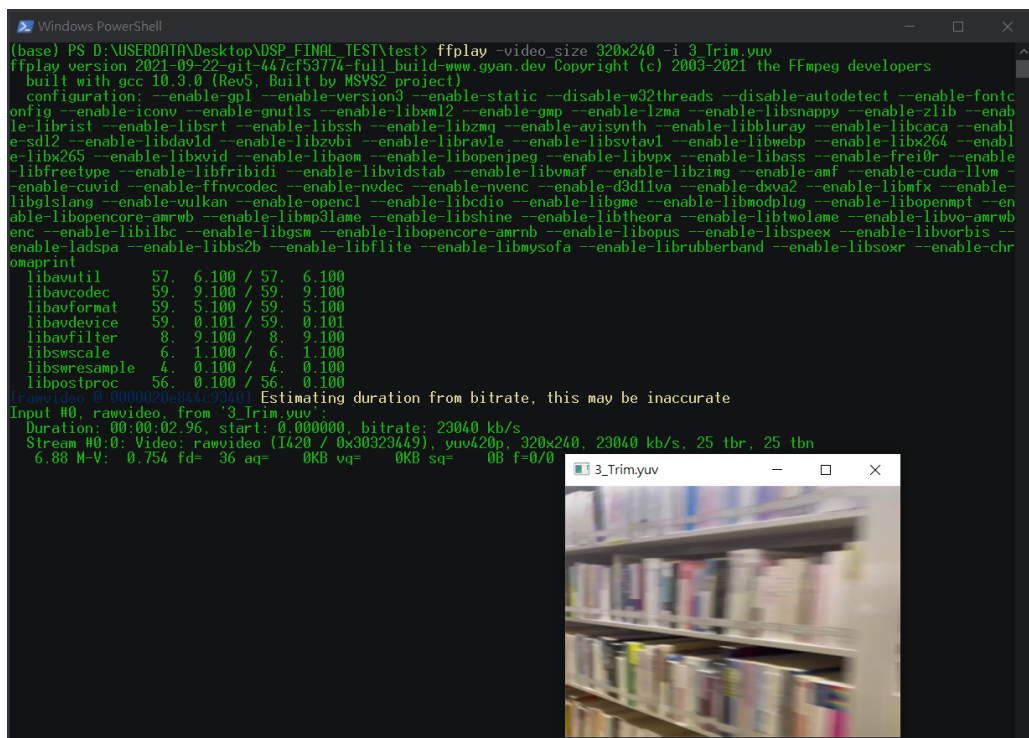

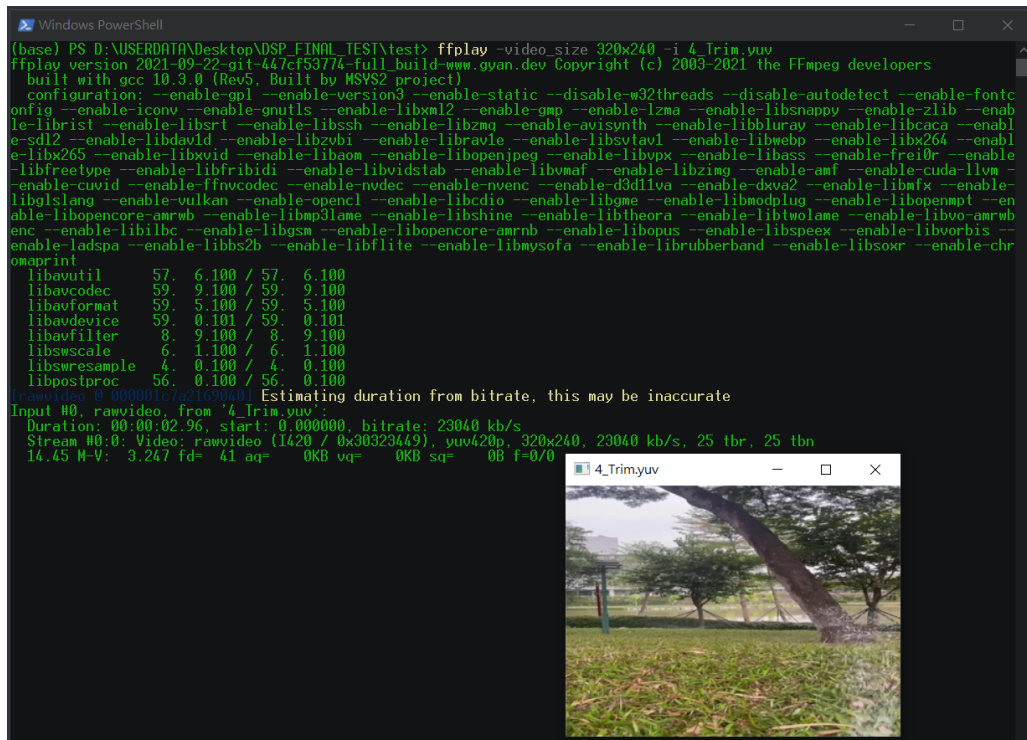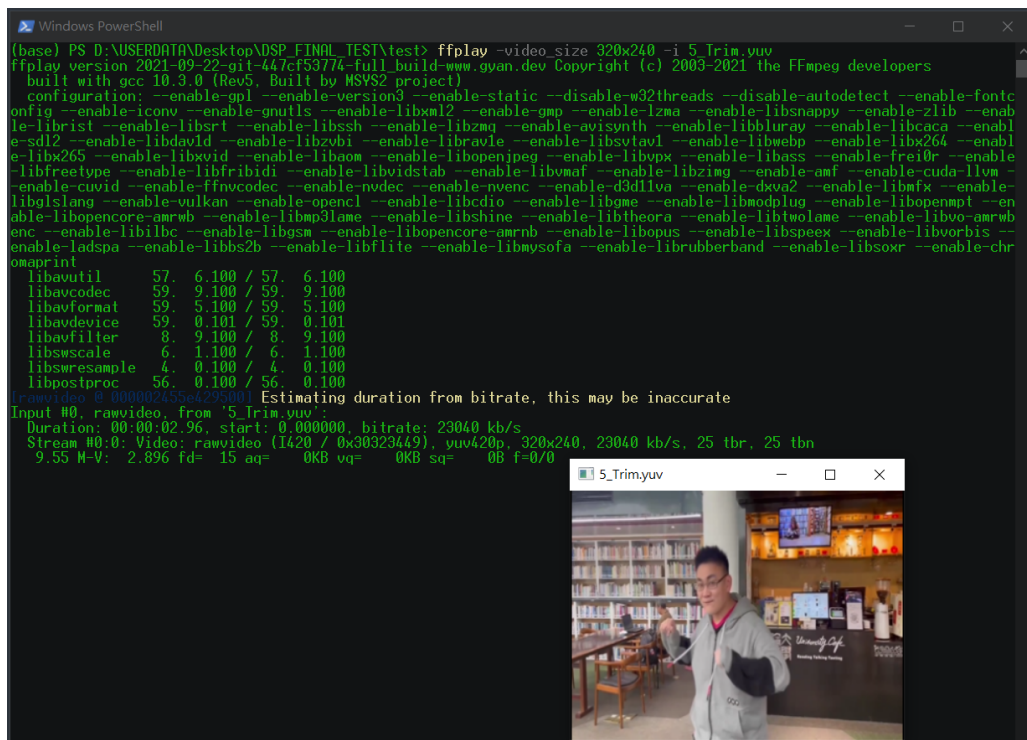Fig. 2. 图书馆咖啡厅
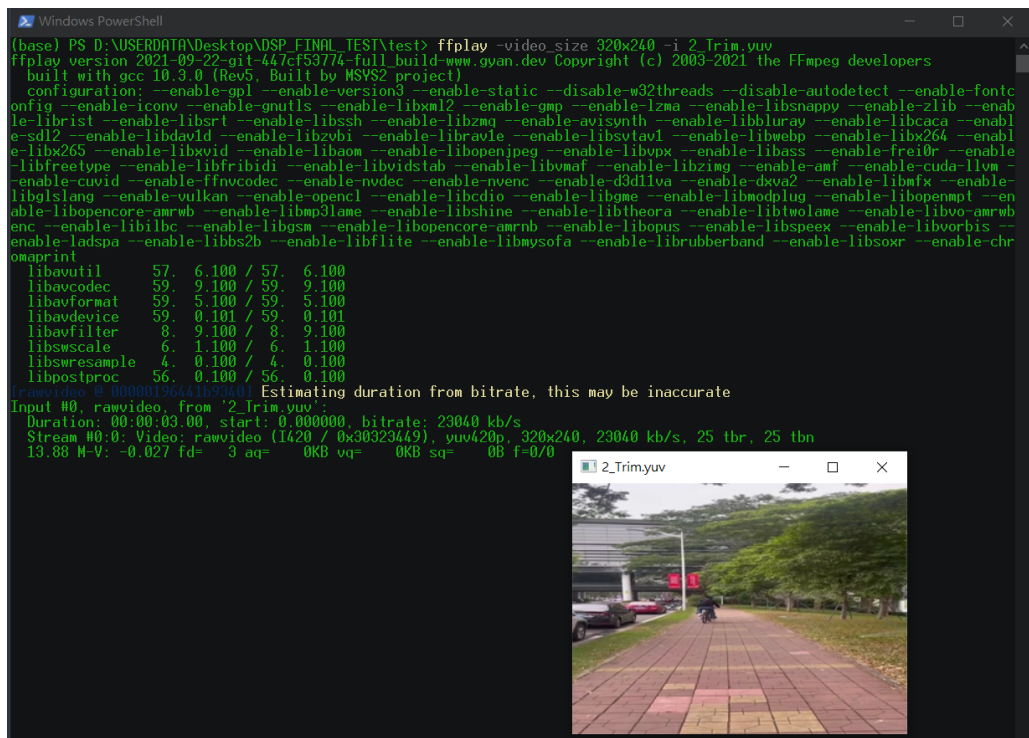
Fig. 3. 图书馆旁的步道

Fig. 4. 图书馆内书架陈列

Fig. 5. 图书馆旁的草皮

Fig. 6. 隐藏人物

4 结果

从实验结果可知，从 10 到 9 的阶段就有很大的效果呈现，而后续有反弹的微幅增加，但随后又下降。。
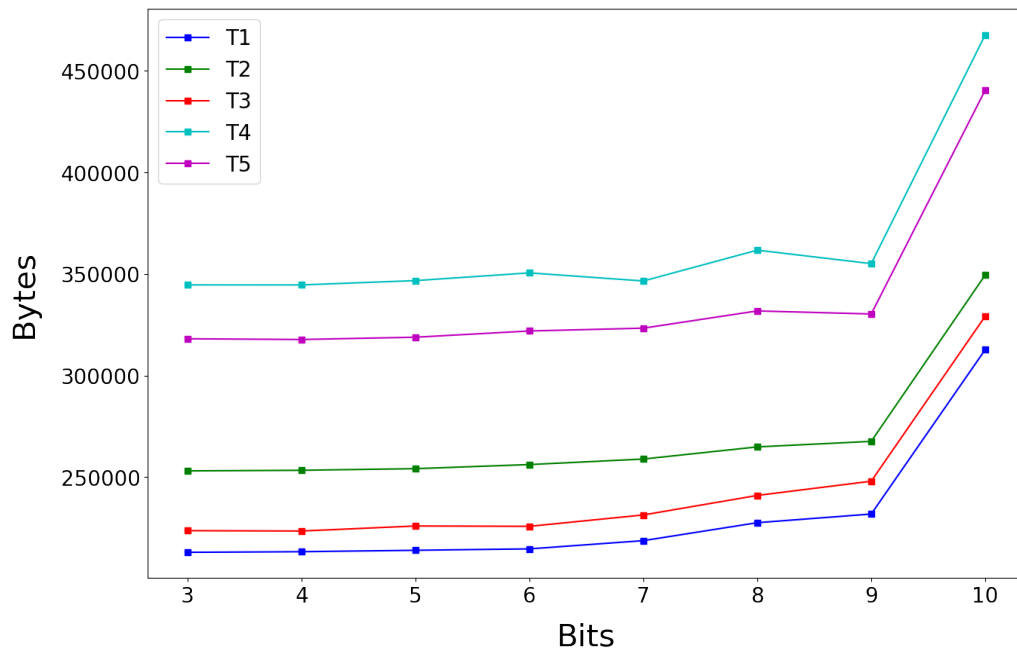
Fig. 7. 测试结果
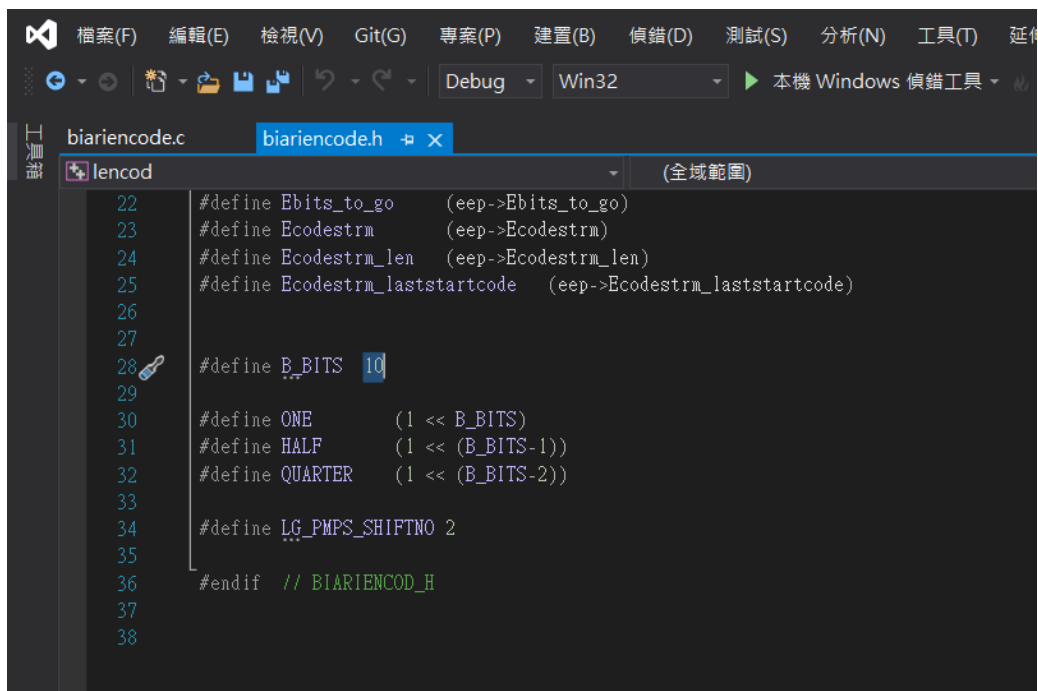
Fig. 8. 改动示意

	A	t1	t2	t3	t4	t5
1		t1	t2	t3	t4	t5
2	3	212,974	253,078	223,633	344,657	318,124
3	4	213,280	253,364	223,457	344,646	317,772
4	5	213,978	254,166	225,934	346,771	318,889
5	6	214,666	256,183	225,771	350,569	321,964
6	7	218,722	258,902	231,373	346,586	323,349
7	8	227,560	264,885	240,985	361,756	331,842
8	9	231,819	267,600	247,982	355,130	330,324
9	10	312,726	349,487	329,182	467,713	440,491

Fig. 9. 数据呈现