ARM® ARM926EJ-S

32-bit Microprocessor

NuMaker NuEZCam
User Guide

For additional information or questions, please contact: Nuvoton Technology Corporation.

www.nuvoton.com

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1 INTRODUCTION

In the beginning we define the NuEZCam solution is that the NuEZCam board connects NuVCOM board as shown in Figure 2–1. In fact, NuVCOM board is NuWicam debug board. In this document, we use NuVCOM board instead of NuWicam debug board because NuVCOM does USB functions including USB VCOM.

NuMaker NuEZCam is the application to run AVI encoder, UVC+UAC and USB MSC of NuEZCam solution, AVI encoder could capture video and audio streams into one AVI file, and save the AVI file into SD card. It is based on Nuvoton's N3290X video MPU and provides a powerful JPEG codec for video encoder. The format of video stream is Motion-JPEG with VGA resolution. If user wants the bigger rsolution, please contact with us for more details. The format of audio stream is PCM, 16 KHz, mono mode. For the application of UVC+UAC, user could run Windows tool AMCAP.exe to see and capture the result of UVC+UAC. As to USB MSC, user could run Windows explorer to see the content of the SD card for AVI encoder, and access the SD card. User could see UART log for NuEZCam solution by the USB VCOM of NuVCOM board. NuMaker_NuEZCam_Arduino_UNO.ino is Arduino sample, and could run under NuEdu UNO board to control NuEZCam solution by pressing the button and the specified flash times of LED is come and release the button.

We also run ARM mbed OS by connecting NUC472 board and NuEZCam solution. The process is the same as Arduino, by using the SW1 button and specified flash time of LED.

In this document, we will describe the chapters as below:

- Board Interface
- Firmware Programming
- Demonstration
- Source code

2 BOARD INTERFACE

2.1 NuEZCam Solution

The NuEZCam solution includes NuEZCam board and NuVCOM board, the both boards connect together as shown in Figure 2–1,

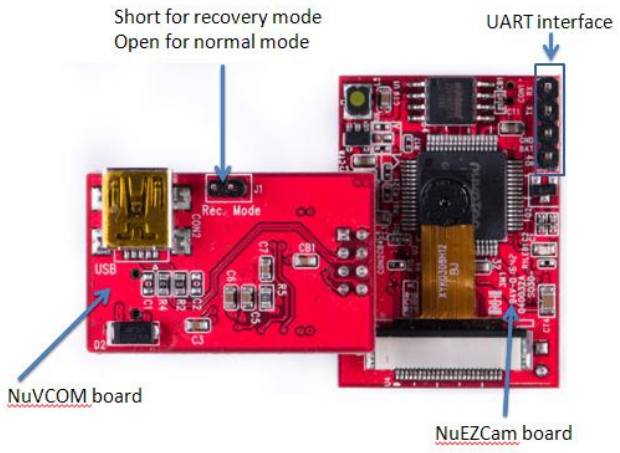
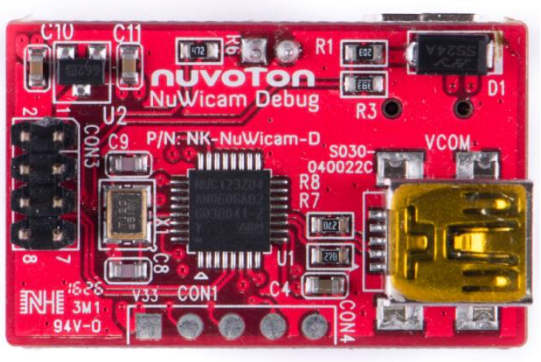


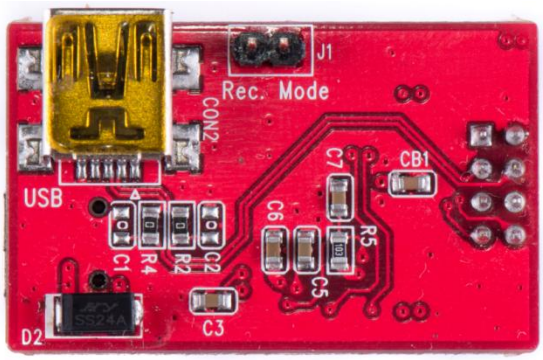
Figure 2–1 View of NuEZCam solution.

NuVCOM board has two USB ports. The front view of NuVCOM board is shown as follows.



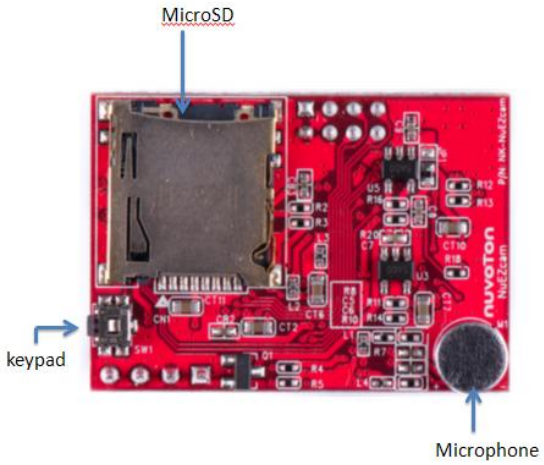
The USB port is for USB VCOM. Before doing USB VCOM, user must install Windows driver VCOM_B002.exe within the subfolder utility of the path https://github.com/OpenNuvoton/NuMaker_NuEZCam_Samples. User should plug USB cable in between NuVCOM board and Windows. User must use the pins of CON3 to connect NuEZCam board to become NuEZCam solution as shown in Figure 2–1. The power of USB cable could work the NuEZCam solution. The status of USB VCOM could be shown in UART log, so the execution result of NuEZCam solution could be shown in UART log by using USB VCOM.

The back view of NuVCOM board is shown as follows.



User could short J1 to set recovery mode, run Windows tool AutoWriter within the subfolder tool\AutoWriter_NuEZCam of the path https://github.com/OpenNuvoton/NuMaker_NuEZCam_Samples, and plug USB cable in between USB port and Windows. Then AutoWriter will burn the binary file AVIEncoder.bin into the SPI flash of NuEZCam solution automatically. About the processing of AutoWriter, please refer to the following chapter Firmware Programming for more details. Open J1 to set normal mode, and plug USB cable into between the USB port and Windows. The NuEZCam solution could execute UVC+UAC or USB MSC for USB applications.

The back view of NuEZCam board is shown as follows.



Before running the solution, user must plug microSD card in MicroSD slot. The audio of AVI encoder and UVC+UAC come from the microphone. The keypad is the input option.

About the hardware information of NuEZCam board and NuVCOM board, user could visit the subfolder hardware_design of the path https://github.com/OpenNuvoton/NuMaker_NuEZCam_RDK for more details.

2.2 NuEdu UNO board

In order to do the solution of NuMaker NuEZCam with Arduino, the setting of NuEdu UNO board should be shown in Figure 2–2. The sample code is located at the subfolder NuMaker_NuEZCam_Arduino_UNO of the the path https://github.com/OpenNuvoton/NuMaker_NuEZCam_Samples. If SW2 is VCOM mode, then the commands of NuEdu UNO board could not communicate with NuEZCam solution. So we must adjust the jumper 2, 3 and 4 to be off, SW2 is UART0 mode, then NuEdu UNO board could work with NuEZCam solution.

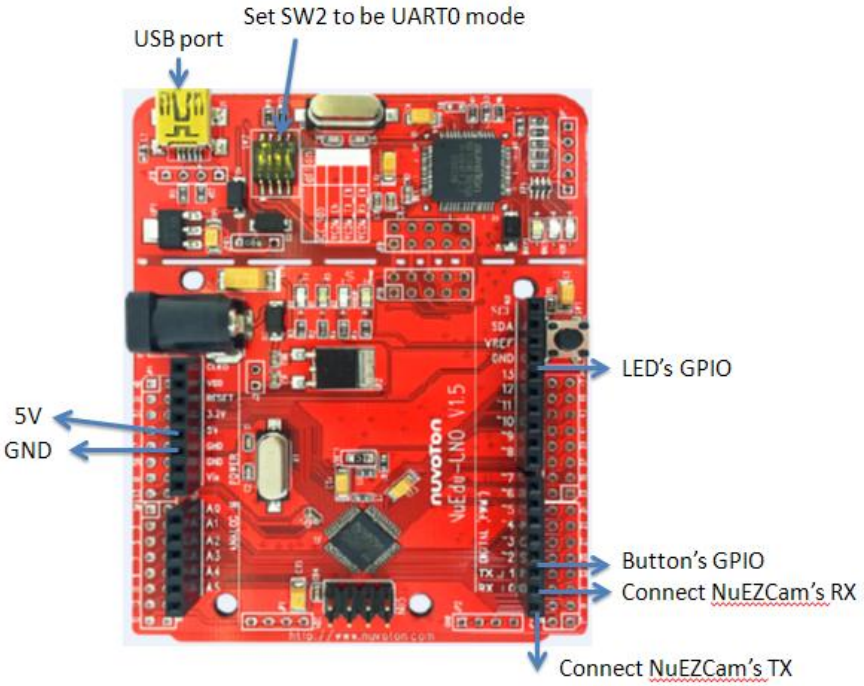


Figure 2–2 The Setting of NuEdu UNO board.

User could connect NuEdu UNO with NuEZCam solution in the following Figure 2–3.

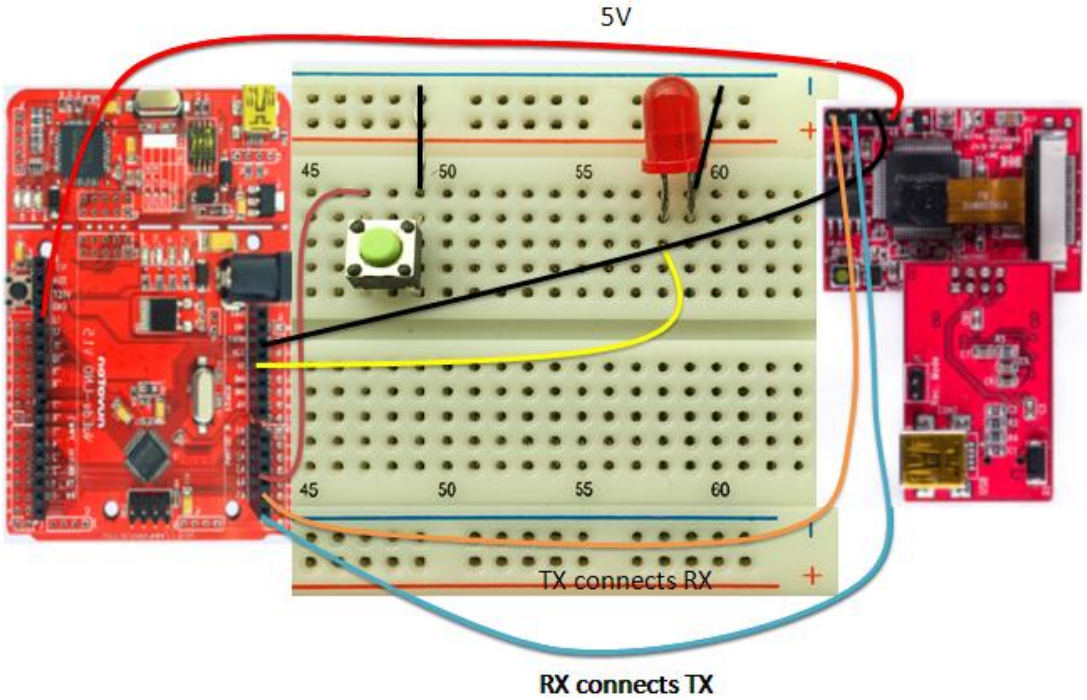


Figure 2–3 The connection between NuEdu UNO board and NuEZCam solution.

Then Arduino's code could control NuEzCam solution by using the button and specified flash times of LED. The specified flash times of LED is the input value for the options. User

presses down the button and see the flash times of LED. As the specified flash times of LED is come and user releases the button to set the input value. User could use NuEZCam solution to see the status of UART log. Then the UART log of NuEZCam solution is message display only. User cannot type in any data to input within the UART log, otherwise maybe NuEdu UNO board fails to connect NuEZCam solution.

2.3 NUC472 board

NUC472 board could connect NuEZCam solution in Figure 2–4. The code of ARM mbed OS (https://developer.mbed.org/compiler/) uses the SW1 button and specified flash times of LED to work. Currently the sample code of ARM mbed OS is located at the path (https://developer.mbed.org/users/shliu1/code/mbed-os-example-NuEZCam/). User could use on-line ARM mbed OS to run Keil to build the project, and obtain the built binary file. Later on user must adjust NUC472 board to be USB mass disk by shorting ICE_VBUS, and plug USB cable in. Windows explorer will display one MBED device, copy the binary file into the device and restart NUC472 board to run. User also opens ICE_VBUS to run debug mode for Keil. Same as NuEdu-Uno board, The specified flash times of LED is the input value for the options. User presses down the SW1 button and see the flash time of LED. As the specified flash times of LED is come and user releases the button to set the input value. Then the UART log of NuEZCam solution is message display only. User cannot key in to input within the UART log, otherwise maybe NuEdu UNO board fails to connect NuEZCam solution.

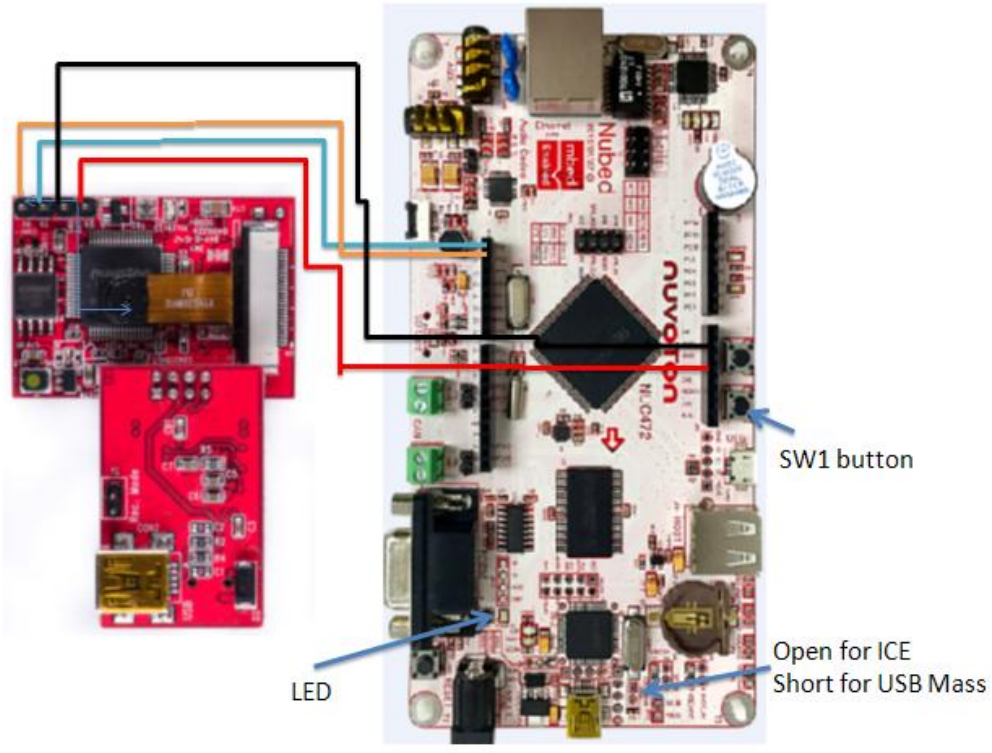


Figure 2–4 The connection between NUC472 board and NuEZCam solution

3 FIRMWARE PROGRAMMING

In this chapter, we will step by step to guide you program the firmware of AVI encoder for NuEZCam solution by using AutoWriter. We release the firmware for AVI encoder as shown the following Figure 3–1.

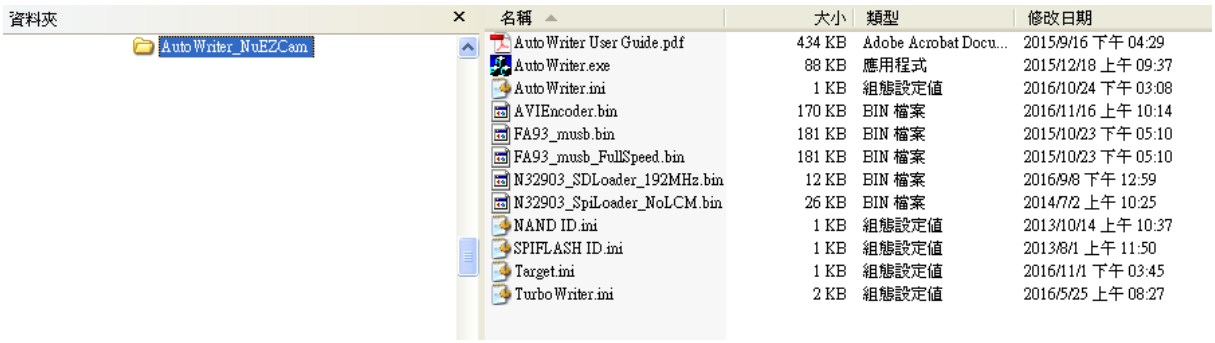


Figure 3–1 Firmware for NuEZCam solution

(1) running AutoWriter.exe execution, the UI of tool is shown in Figure 3–2. **The 'Current Target' is SPI by default**. Please keep the setting and follow the below steps:

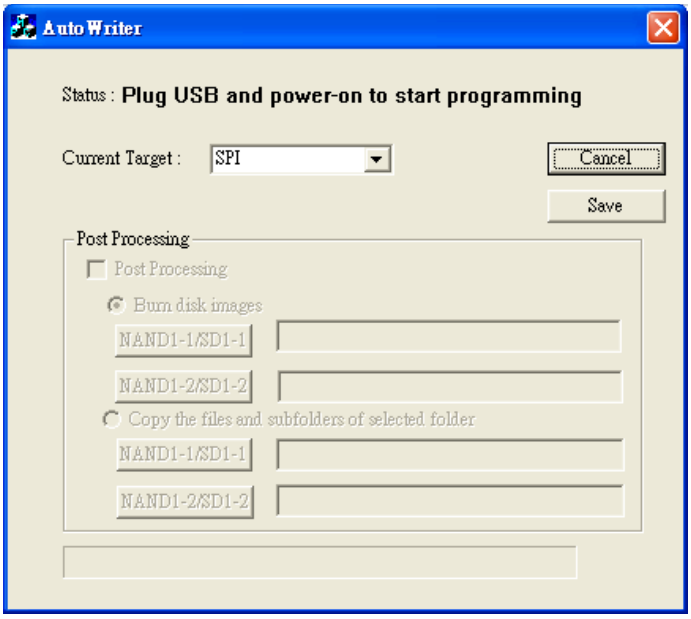


Figure 3–2 UI of AutoWriter

(2) sets the NuEZCam solution to be recovery mode, it means to short J1 pins of NuEZCam solution shown in Figure 3–3, and plug USB cable into PC/NB.

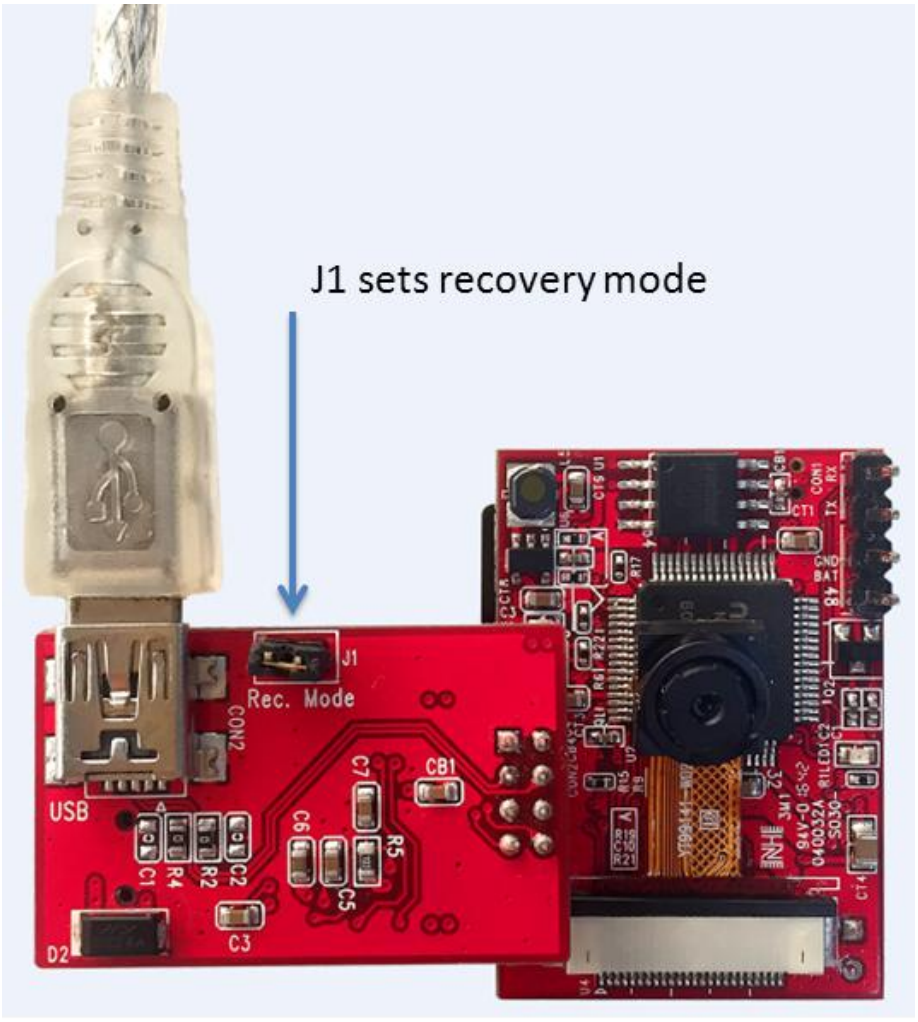
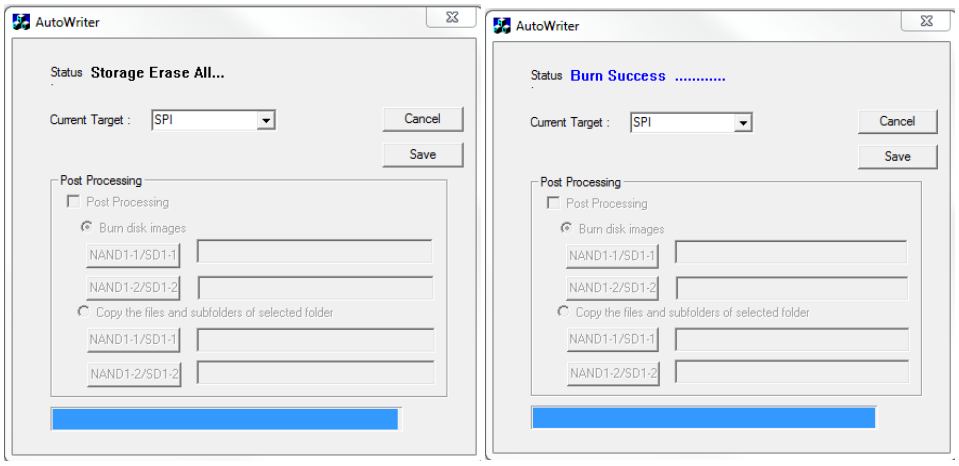


Figure 3–3 Booting setting in recovery mode

(3) Start the NuEZCam solution, the tool AutoWriter will burn the firmware automatically as follows



(4) After finishing firmware programming, the UI will show ‘Burn Success ….. ’.
(5) To Un-plug USB Line from PC.
(6) To leave ‘Recovery Mode’ and set ‘Normal mode’ by adjusting J1 to be open.

Then the operations of AutoWriter is finished.

4 DEMOSTRATION

In this chapter, we will demonstrate the solution of NuMaker NuEZCam by running NuEZCam solution alone mainly.

For NuEZCam solution alone, user presses down and releases the keypad to decide the input. User also could connect USB VCOM of NuEZCam solution to see UART log as follows.

```
Init RTC....OK
DDR size:  8MB
SD Port0 Booting Fail - No Check ID
NAND Booting (Not support/No Device) Fail - No Check ID
SPI Booting Success
Clock Skew
 DQSODS 0x1010
 CKDQSDS 0x888800
Code Executes at 0x00700000
SPI Loader start (20131220).
DAC On
Load Image Load file length 0x400, execute address 0x80706764
Load file length 0x29C04, execute address 0x0
Jump to kernelDisable USB Transceiver
Disable ADC and LVR
Disable SPU and ADO
Disable USB phy
The code is for N32903
============================================================
Please select the target
============================================================
============================================================
 [1] AVI Encoder
 [2] USB UVC+UAC
 [3] USB MSC
============================================================
```

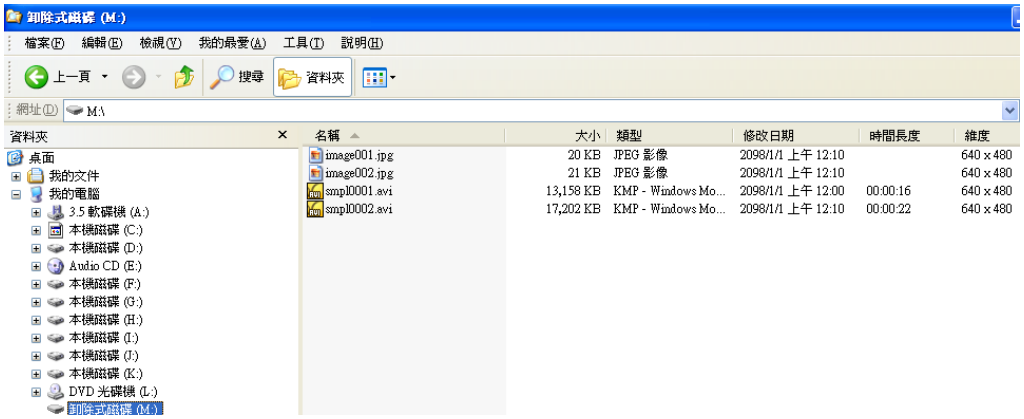
Press down the keypad for 1 second and release right now, the options [1] AVI Encoder is set to run. Press down the keypad for 2 seconds and release right now, the options [2] USB UVC+UAC is set to run. Press down the keypad for 3 seconds and release right now, the options USB MSC is set to run. The solution sets AVI Encoder to execute and LED will flash on and off. Press down and release the keypad for two times within 600 ms, it will capture one image. Press down the keypad for 1 seconds and release, it will stop AVI encoder. If user does not press down the keypad and release to stop AVI encoder. The current execution time is 120 seconds. The following UART log displays the status of AVI encoder.

```
Key in select 1
Start Record
Press 1 to stop, 2 to capture one image !
Initial SD NonOS Driver (20161207) for SD port 0
SD total size =   3B0800
Sensor ID = 7
Device Slave Addr = 0x42
Sensor ID0 = 0xE8
Sensor ID0 = 0x2
Sensor ID0 = 0x49
Sensor ID0 = 0x9A
Sensor ID0 = 0x35
Sensor ID0 = 0xF
Sensor GC0308 is OK
encoded file = C:\smpl0001.avi
fsSetFileSize as 127 MB
fsSetFileSize take time ticks: 15
PLL clock = 184,363 KHz
Total divider = 9
DIV_N1, DIV_N0  = 3, 3
g_u32RecorderByte 32
T=1.03  (Vid #31 - 31) (Audio #28)
T=1.86  (Vid #56 - 25) (Audio #3,928)
T=3.13  (Vid #94 - 38) (Audio #32)
T=4.16  (Vid #125 - 31) (Audio #100)
T=5.20  (Vid #156 - 31) (Audio #368)
T=6.23  (Vid #187 - 31) (Audio #36)
T=7.26  (Vid #218 - 31) (Audio #104)
T=8.26  (Vid #248 - 30) (Audio #304)
T=9.30  (Vid #279 - 31) (Audio #172)
T=10.33  (Vid #310 - 31) (Audio #240)
T=11.36  (Vid #341 - 31) (Audio #108)
SnapShot one file C:\image001.jpg
T=12.40  (Vid #372 - 31) (Audio #176)
T=13.43  (Vid #403 - 31) (Audio #44)
T=14.43  (Vid #433 - 30) (Audio #244)
T=15.46  (Vid #464 - 31) (Audio #112)
T=16.50  (Vid #495 - 31) (Audio #380)
T=17.53  (Vid #526 - 31) (Audio #48)
T=18.53  (Vid #556 - 30) (Audio #248)
AVI record done.
================================================================
 [1] AVI Encoder
 [2] USB UVC+UAC
 [3] USB MSC
```

Back to the options of three applications. User should set USB MSC to see the result of AVI encoder. Before doing the option 2 USB UVC+UAC and 3 USB MSC, user should connect USB cable between NuEZCam solution and PC/NB, press down the keypad for 3 seconds and release right now, the options USB MSC is set to run. UART log is shown as follows.

```
N3290 UDC Library (20150820)
Initial SD NonOS Driver (20160602 SDO_CD) for SD port 0
N3290 MSC Library (20151208)
MSC - SD Card detect pin is in use
```

User will find one USB disk under Windows explorer as follows, and checks the result of AVI encoder.



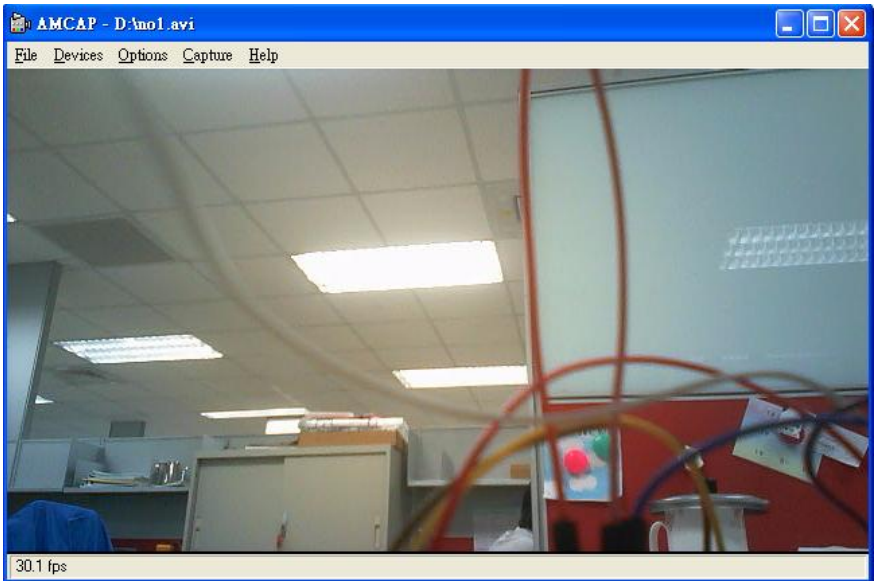
If user would like to end the process, plug USB cable out and UART log is shown as follows.

```
================================================================
 [1] AVI Encoder
 [2] USB UVC+UAC
 [3] USB MSC
================================================================
```

Before doing the option 2 USB UVC+UAC, user must connect USB cable between NuEZCam solution and PC/NB, press down the keypad for 2 seconds and release right now, the options [2] USB UVC+UAC is set to run. The UART log is shown as follows,

```
Key in select 2
Sensor ID = 7
Device Slave Addr = 0x42
Sensor IDO = 0xE8
Sensor IDO = 0x2
Sensor IDO = 0x49
Sensor IDO = 0x9A
Sensor IDO = 0x35
Sensor IDO = 0xF
Sensor GC0308 is OK
N3290 UDC Library (20150820)
N3290 UAVC Library (20141217)
PLL clock = 184,363 KHz
Total divider = 9
DIV_N1, DIV_N0  = 3, 3
g_u32RecorderByte 32
USB cable in
```

and user could run the Windows tool AMCAP.exe to see the status.



If user would like to end the processing, close the tool AMCAP.exe and plug out the USB cable. UART log will be shown as follows.

```
UVC end
================================================================
 [1] AVI Encoder
 [2] USB UVC+UAC
 [3] USB MSC
================================================================
```

As to NuEZCam solution + NuEdu UNO board, user connects between NuEZCam solution and NuEdu UNO board like Figure 2–3.

The processing between NuEZCam solution alone and NuEZCam solution + NuEdu UNO board are different. For NuEZCam solution + NuEdu UNO board, user runs Arduino code NuMaker_NuEZCam_Arduino_UNO.ino to press down the button and see the flash of LED for one time and release the button, then Arduino code runs the option 1 AVI encoder by using UART protocol command. Laterly LED will flash for three time automatically to acknowledge. If LED could flash many time, it means that the UART protocol command fails, then user must

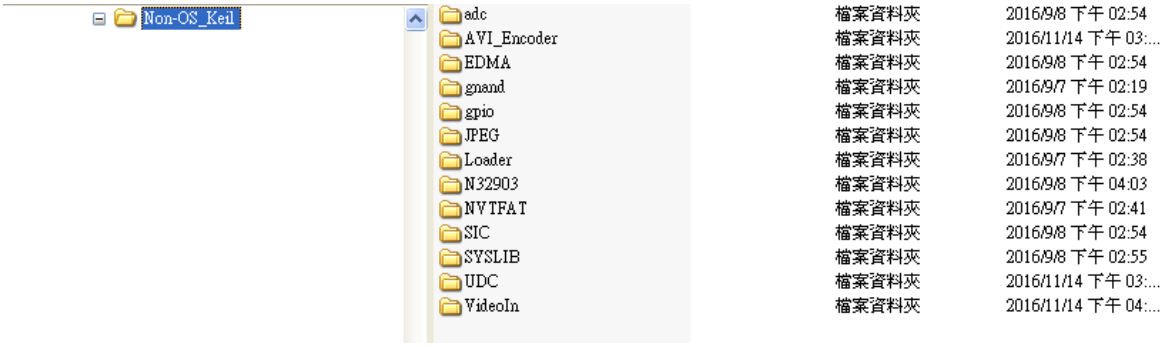
check the status of NuEZCam solution + NuEdu UNO board. Currently the flash number of LED is the input. The flash number is 1 and runs the option 1 AVI encoder, 2 runs the option 2 USB UVC+UAC, 3 runs the option 3 USB MSC, 4 runs to stop AVI encoder, 5 runs to capture one image during AVI encoder. User could check the file NuMaker_NuEZCam_Arduino_UNO.ino to understand the program easily. About the definition of UART protocol command, user could refer to the document "UART protocol for NuEZCam.pdf" for more details.

As to NuEZCam solution + NUC472 board, user connects between NuEZCam solution and NUC472 board like Figure 2–4.
The processing between NuEZCam solution + NuEdu UNO board and NuEZCam solution + NUC472 board are the same. For NuEZCam solution + NUC472 board, user runs the code of mbed OS main.cpp to press down the button and see the flash of LED for three times and release the button, then code of mbed OS runs the option 3 USB MSC by using UART protocol command. Laterly LED will flash for three time automatically to acknowledge. If LED could flash many times, it means that the UART protocol command fails. Currently the flash number of LED is the input. The flash number is 1 and runs the option 1 AVI encoder, 2 runs the option 2 USB UVC+UAC, 3 runs the option 3 USB MSC, 4 runs to stop AVI encoder, 5 runs to capture one image during AVI encoder. User must check the status of NuEZCam solution + NUC472 board. User could check the file main.cpp to understand the program easily. About the definition of UART protocol command, user could check the document "UART protocol for NuEZCam.pdf" for more details.

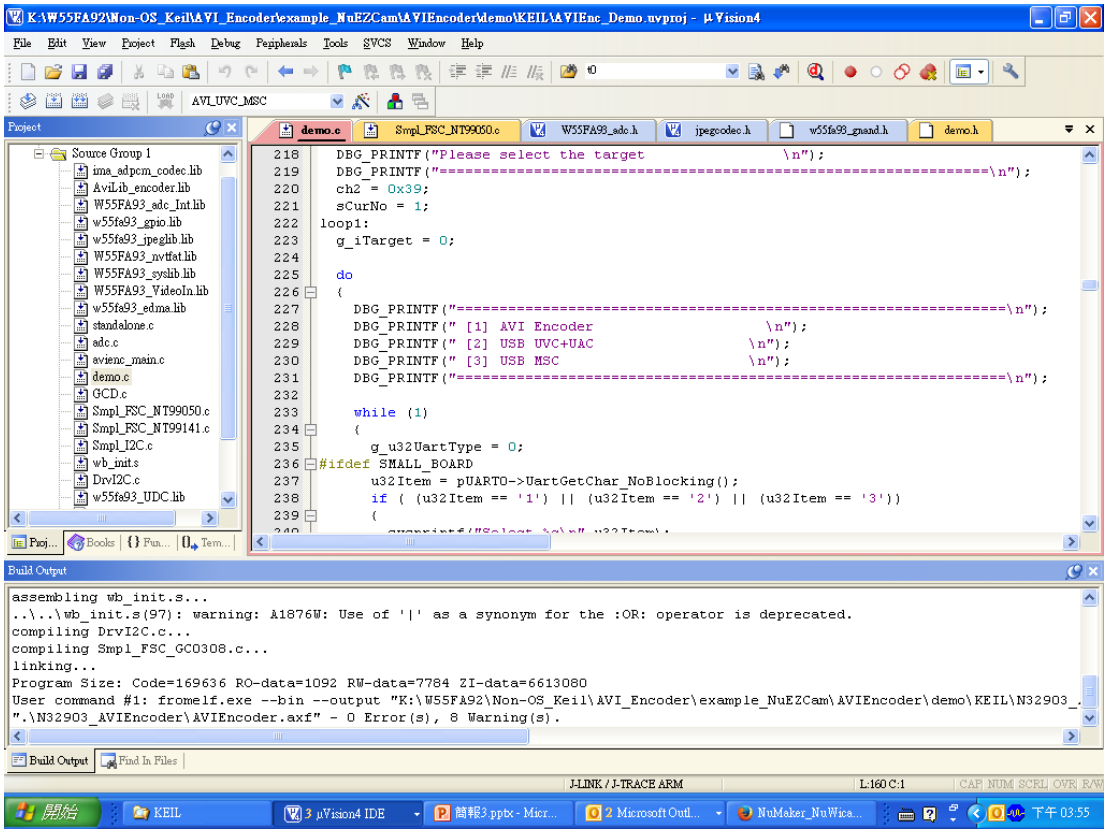
5 SOURCE CODE

The source code of AVI encoder is built by Keil. Currently the application supports the sensor GC0308 (VGA, 30 FPS).

The source code of Non-OS Keil is shown as follows.



User could open the project AVIEnc_Demo.uvproj within the subfolder AVI_Encoder\example_NuEZCam\AVIEncoder\demo\KEIL to build and export one binary file AVIEncoder.bin.



If user would like to use the other sensor, please contact Nuvoton for more information.

6 Q&A

Q: How does user build the source code of AVI encoder ?

A: User could unzip the file Non-OS_KeilBSP.7z, and build the project AVIEnc_Demo.uvproj within the folder AVI_Encoder by using Keil 4.54 later. Keil is not a free software.

Q: How many boards could do with NuEZCam under mbed OS ?

A: Nuvoton's NUC472 and M453, STM32F401, NXP K64F.

7 REVISION HISTORY

Date	Revision	Description
2017.02.09	1.03	1. Use keypad instead of keyboard.
2016.12.05	1.02	1. Use NuEZCam solution.
2016.09.13	1.01	1. Initially issued.

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