ARM® ARM926EJ-S

32-bit Microprocessor

NuMaker NuEZCam
User Guide

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

www.nuvoton.com

Table of Contents

1 INTRODUCTION

NuMaker NuEZCam is the solution to run AVI encoder, UVC+UAC and USB MSC of N32903 board, 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 N32903 video MPU. N32903 provides a powerful JPEG codec for encoding. The firmware of AVI encoder provides audio and video streams. The format of video stream is Motion-JPEG with VGA/HD(720P) resolution. The format of audio stream is PCM or IMAADPCM. N32903 could capture the video and audio streams into the AVI file, and save the AVI file into SD card. User could run Windows tool AMCAP.exe to see and capture the result of UVC+UVC. As to the solution USB MSC, user could run Windows explorer to see the content of the SD card for NuEZCam board. Arduino sample NuMaker_NuEZCam_Arduino_UNO.ino runs NuEdu UNO board to control N32903 board by using UART protocol.

In this document, we will describe chapters as below:

- Board Interface
- Firmware Programming
- Source code

2 BOARD INTERFACE

2.1 Introduction of NuEZCam Board

The NuEZCam demo board includes NuEZCam board and NuWiCam debug board, it is shown in the following Figure 2-1,

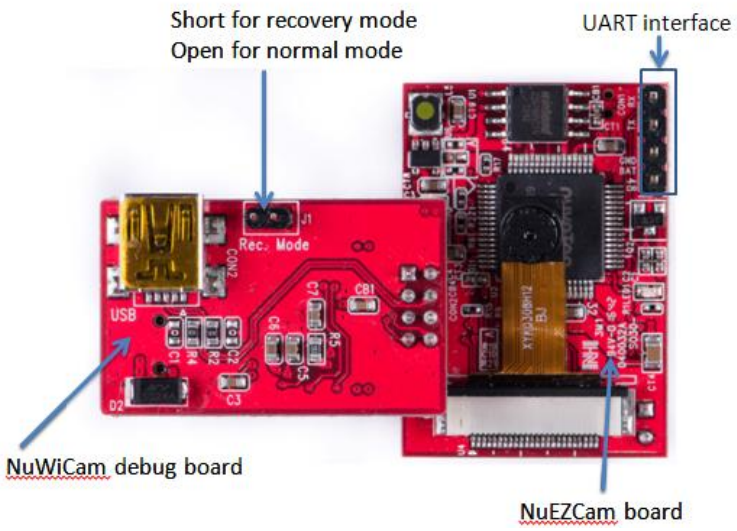
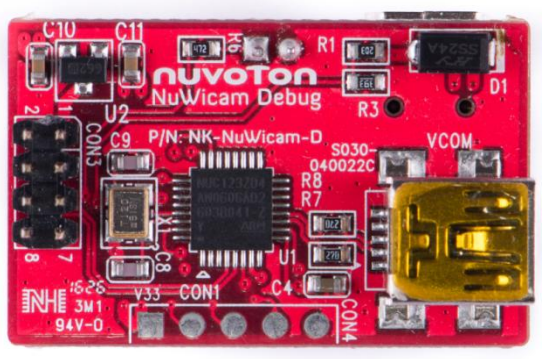


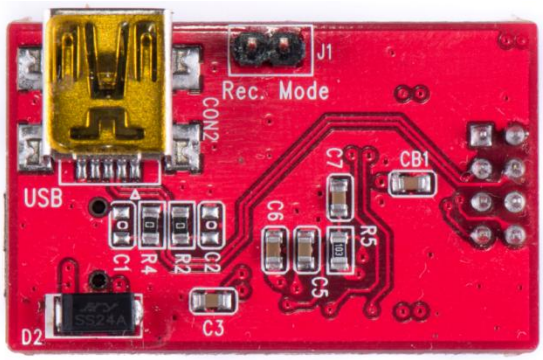
Figure 2-1 View of NuEZCam board and NuWiCam debug board.

NuWiCam debug board could use Windows tool AutoWriter to download the binary code into the SPI flash of NuEZCam by using recovery mode. The front view of NuWiCam debug board is shown as follows.



The USB connector is for USB VCOM. Before doing USB VCOM, user must install Windows driver within the subfolder Tool\NUC123_Driver\VCOM_B002.exe. User should plug USB cable in between NuWicam debug board and Windows. The power of USB cable could work the NuWicam debug board and NuEZCam board. User must use the pins of CON3 to connect NuEZCam board as shown in Figure. 2-1. The status of USB VCOM could be shown in UART log for debug, so the execution result of NuEZCam board could be shown in UART log by using USB VCOM.

The back view of NuWiCam debug board is shown as follows.



User could short J1 to set recovery mode, open Windows tool AutoWriter, and plug USB cable in between USB connector of back view and Windows. Then AutoWriter will burn the binary file AVIEncoder.bin into the SPI flash of NuEZCam board automatically. Open J1 into normal mode, and plug USB cable into between the USB connector for the front view of NuWicam debug board and Windows. The SPI flash of NuEZCam board will execute the binary file AVIEncoder.bin.

The back view of NuEZCam board is shown as follows.

Before running the program, user must plug microSD card in MicroSD slot. The audio recorder of AVI encoder and UVC+UAC comes from the microphone of back view.

2.2 NuEdu UNO board

In order to do the solution of NuMaker NuEZCam, The setting of NuEdu UNO board should be shown in Figure 2-2. If SW2 is VCOM mode, then the commands of NuEdu UNO board could not communicate with NuEZCam board. So we adjust the jumper 2, 3 and 4 to be off, then SW2 is UART0 mode,

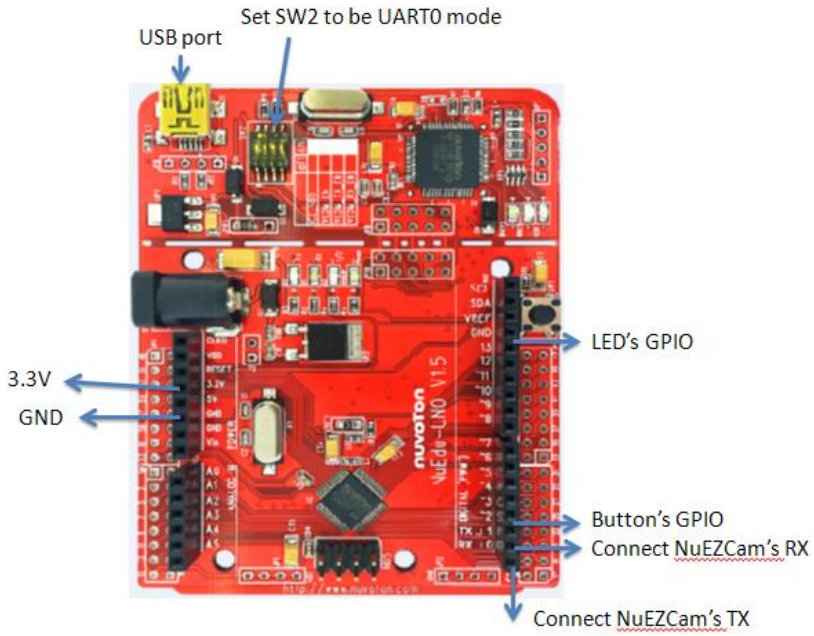
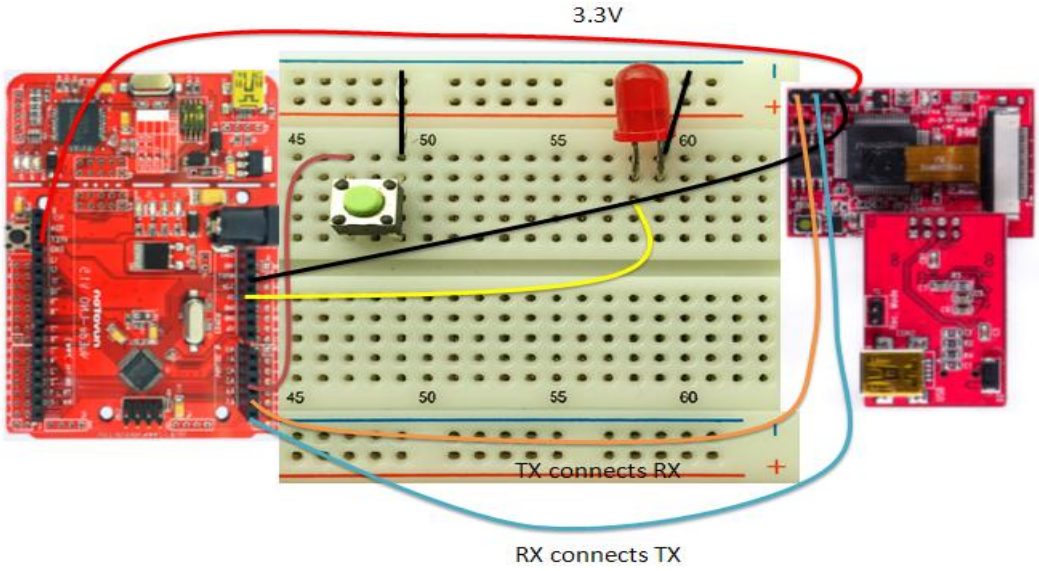


Figure 2-2 The Setting of NuEdu UNO board.

User could connect NuEdu UNO with NuEZCam board as follows.



Then Auduino's code could control NuEzCam board by using UART control. User could connect USB VCOM of NuWicam board to see the status of UART log.

2.3 NUC472 board

NUC472 board could connect NuEZCam board by using UART protocol to work mbed OS (https://developer.mbed.org/compiler/) in Figure 2-3. User could use on-line mbed OS to run Keil to build the project, and obtain the built binary file. Now user must adjust NUC472 board to be USB mass disk by short ICE_VBUS, and plug USB cable in. Windows explorer will display one MBED device, copy the binary file into the device and open ICE_VBUS to restart

NUC472 board to run.

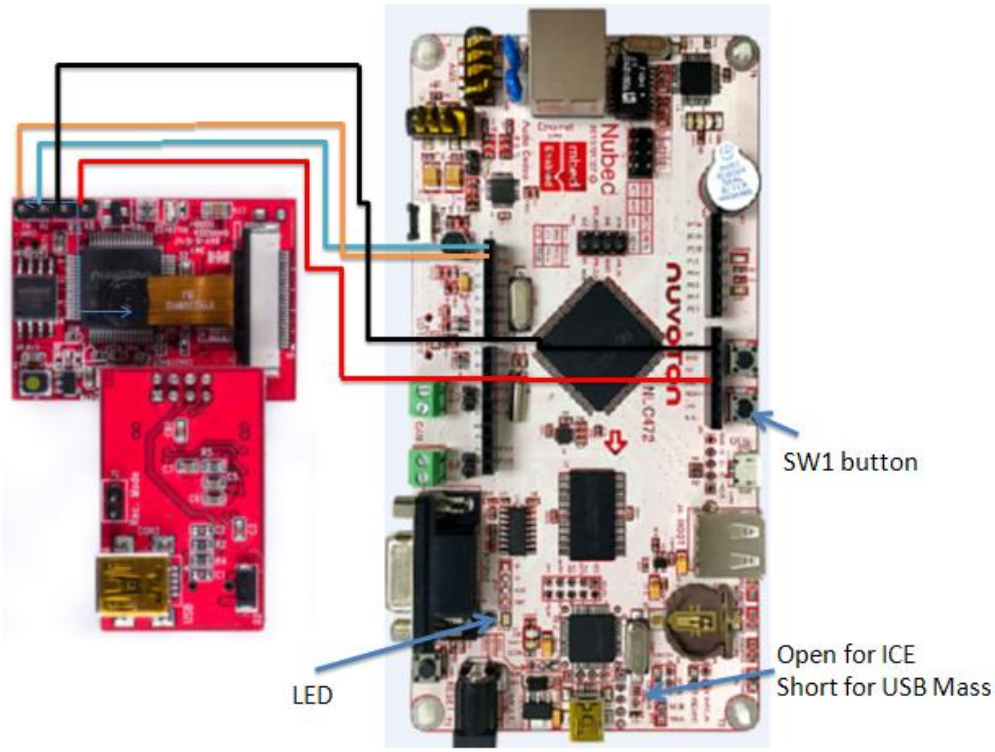


Figure 2-3 The connection between NUC472 board and NuEZCam board

3 FIRMWARE PROGRAMMING

In this chapter, we will step by step to guide you program the firmware of AVI encoder for NuEZCam board using AutoWriter. We released the firmware for AVI encoder as shown the following figure.

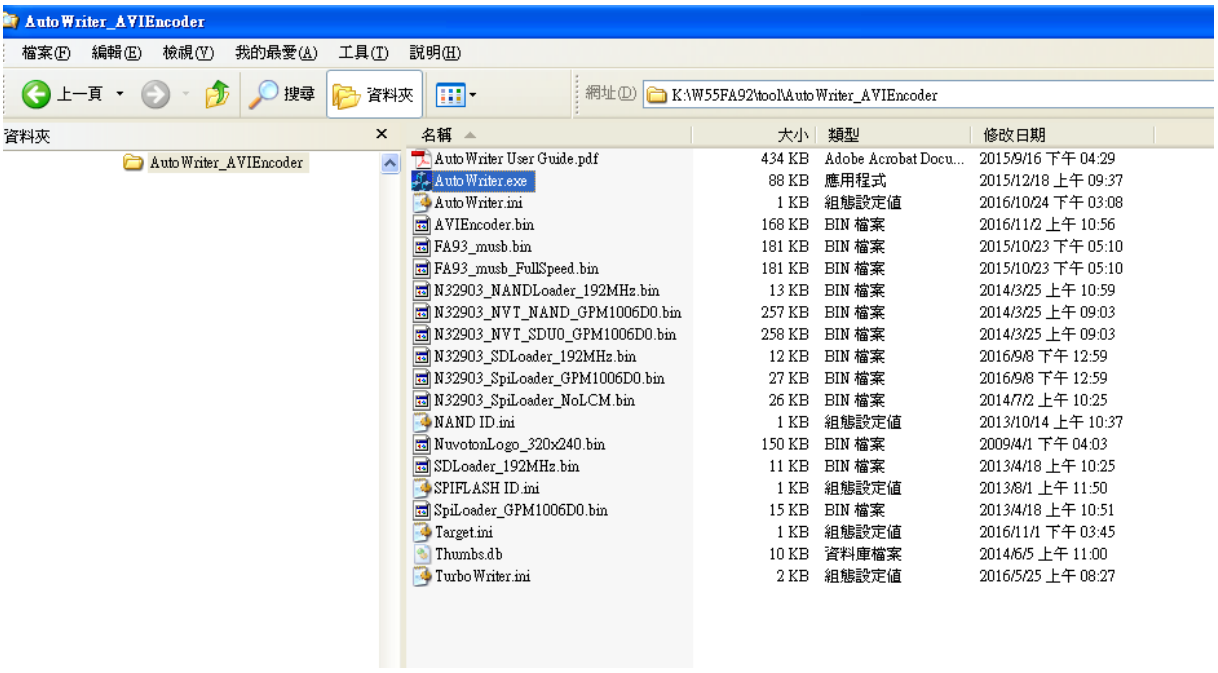


Figure 4-1 Firmware for NuEZCam board

(1) running AutoWriter.exe execution, the UI of tool is shown as follows. **The 'Current Target' is SPI by default**. Please keep the setting and following below steps:

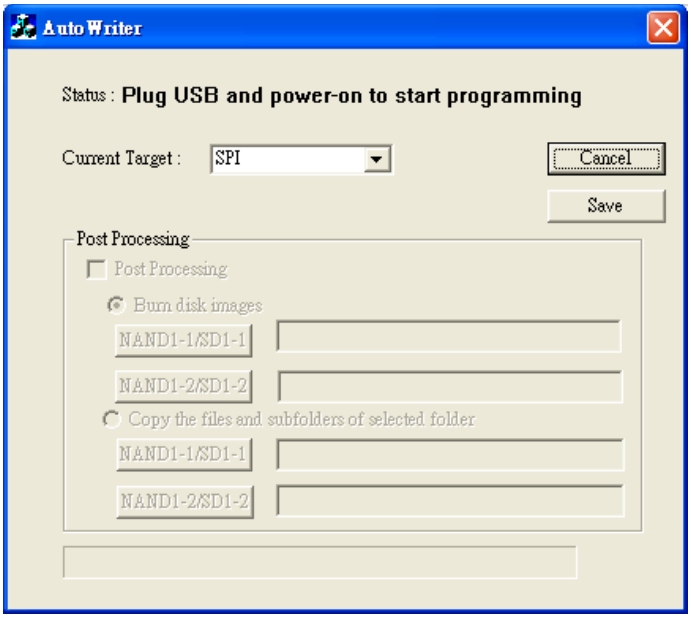


Figure 4-2 Current Target in SPI mode

(2) sets the NuEZCam board to be recovery mode, it means to short J1 pins of NuWicam

debug board shown in Figure 4-3, and plug USB cable into PC/NB.

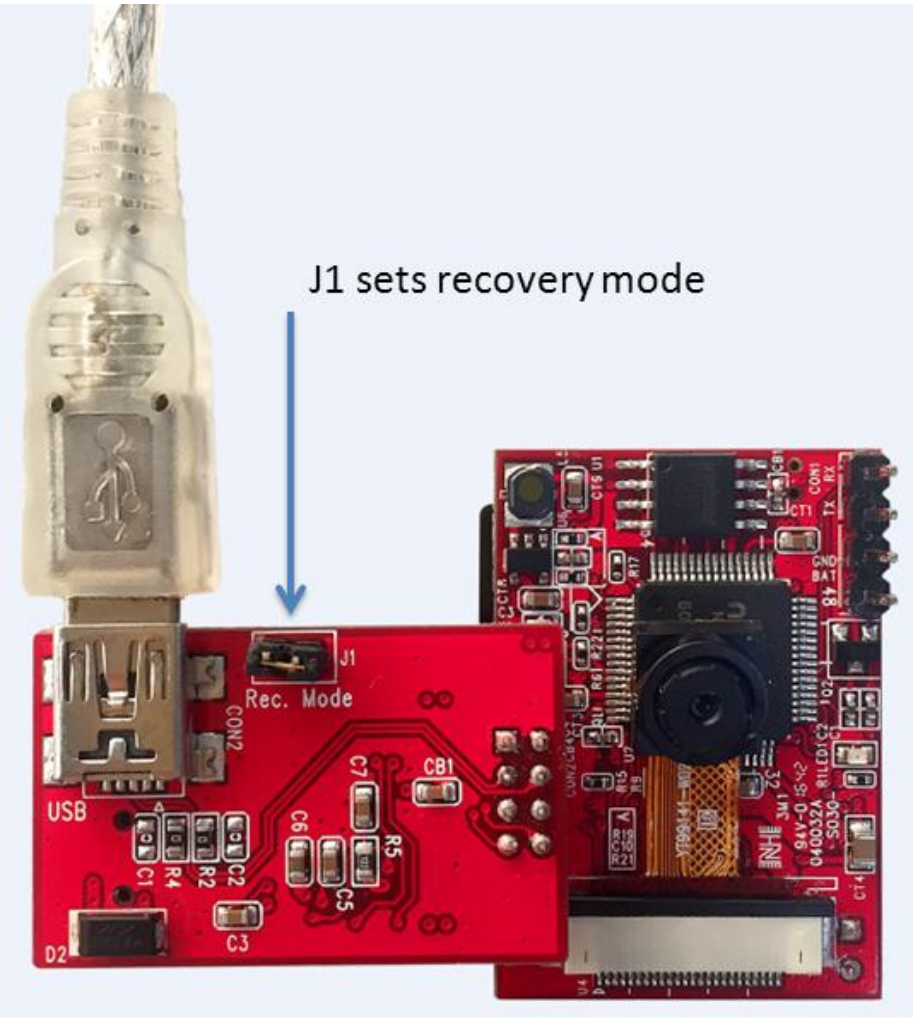
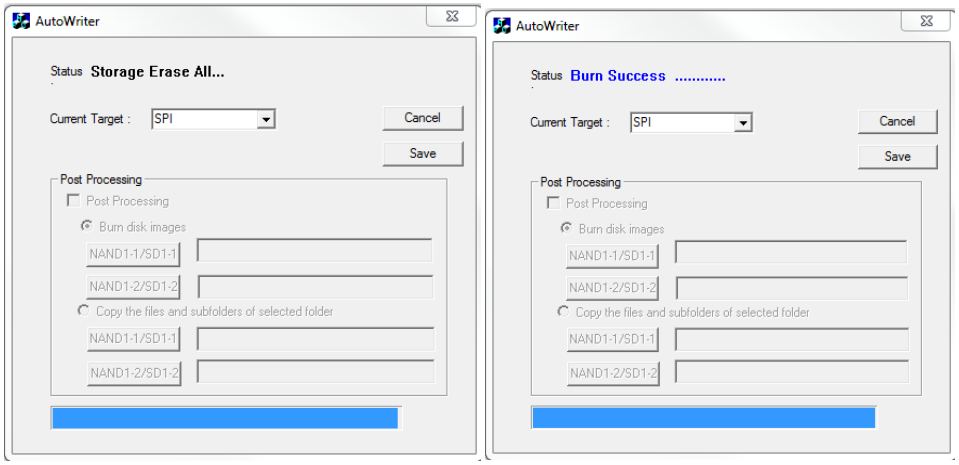


Figure 4-3 Booting setting in recovery mode

(3) Start the NuEZCam board, 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.
(7) Connect NuEdu UNO board and NuEZCam board by UART protocol. When the program is running, user presses down the button and LED flashes. LED flashes one time and release the button, it means to input 1 to UART log, and later LED flashes 3 times to acknowledge. What times does LED flash and release the button ? it means input the specified times to UART log, and later LED flashes 3 times to acknowledage. If the acknowledage does not display, the input of UART log must fail. User will see the result from the UART log of NuWicam debug board.

For example, booting the normal mode of the NuEZCam board, you will see UART log as follows. User runs Arduino code NuMaker_NuEZCam_Arduino_UNO to press down the button. When the LED flashs 2 times, release the button and the input value of UART is 2. The program sets 2 to run the resolution HD. For the camera status, press down the button, user does not release the button until LED flashes 1 times. Then the program sets 1 to run normal photography. After running over 7 seconds, set 1 to stop record. User could connect USB VCOM of NuWicam board to see the status of UART log. The detailed status of UART log is shown 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
============================================================
```

User clicks down the button of NuEdu UNO board to flash LED for one time and release the button, the program selects [1] AVI Enocder to execute as follows.

```
============================================================
 [1] NT99050 demo - 640X480
 [2] GC0308 demo - 640X480
 [3] NT99141 demo - 1280X720
 [4] Exit
============================================================
```

Now our solution supports three sensors, NT99050, GC0308 and NT99141. User must select the correct sensor to do, otherwise it fails to work. After setting the sensor, UART log will be shown as follows.

```
Camera status
 [1] Normal photography
 [2] Time lapse photography
 [3] Exit
```

There are three options, select [1] by click down the button to flash LED for one time and release the button, it will run as follows. During the process of AVI encoder, the encoded video and audio will be saved into AVI file. User could select 1 to stop the process, or select 2 to capture one image and save into one JPEG file.

```
Initial SD NonOS Driver (20160602 SDO_CD) for SD port 0
Sensor ID = 7
Device Slave Addr = 0x42
Sensor fail !
Please check the sensor !
Sensor ID = 8
Device Slave Addr = 0x54
Detectd sensor id0=14 id1=10
Sensor NT99141 is OK
encoded file = C:\smpl0001.avi
fsSetFileSize as 103 MB
fsSetFileSize take time ticks: 9
PLL clock = 184,363 KHz
Total divider = 9
DIV_N1, DIV_N0  = 3, 3
g_u32RecorderByte 32
T=1.04  (Vid #25 - 25) (Audio #118)
T=2.04  (Vid #49 - 24) (Audio #318)
T=3.08  (Vid #74 - 25) (Audio #52)
T=4.12  (Vid #99 - 25) (Audio #186)
T=5.12  (Vid #123 - 24) (Audio #386)
T=6.16  (Vid #148 - 25) (Audio #320)
T=7.20  (Vid #173 - 25) (Audio #254)
T=8.25  (Vid #198 - 25) (Audio #388)
T=9.29  (Vid #223 - 25) (Audio #322)
T=10.33  (Vid #248 - 25) (Audio #256)
T=11.37  (Vid #273 - 25) (Audio #390)
T=12.41  (Vid #298 - 25) (Audio #124)
T=13.45  (Vid #323 - 25) (Audio #58)
T=14.45  (Vid #347 - 24) (Audio #258)
T=15.50  (Vid #372 - 25) (Audio #392)
T=16.54  (Vid #397 - 25) (Audio #326)
T=17.58  (Vid #422 - 25) (Audio #260)
T=18.62  (Vid #447 - 25) (Audio #194)
T=19.62  (Vid #471 - 24) (Audio #394)
T=20.66  (Vid #496 - 25) (Audio #328)
Stop record
AVI record done.
================================================================
 [1] AVI Encoder
 [2] USB UVC+UAC
 [3] USB MSC
================================================================
```

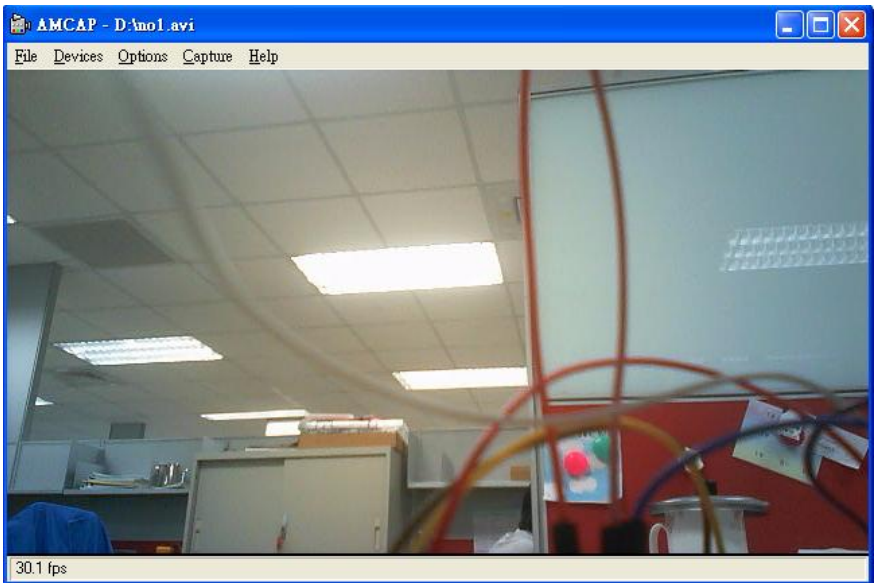
For option 2 and 3, Before selecting option 2 and 3, user must connect USB cable between NuEZCam board and PC/NB. If user select 2, the UART log is shown as follows,

```
================================================================
 [1] NT99050 demo - 640X480
 [2] GC0308 demo - 640X480
 [3] NT99141 demo - 1280X720
 [4] Exit
================================================================
```

Now our solution supports three sensors, NT99050, GC0308 and NT99141. User must select the correct sensor to do, otherwise it fails to work. After setting the sensor, UART log will be shown as follows.

```
Sensor ID = 7
Device Slave Addr = 0x42
Sensor fail !
Please check the sensor !
Sensor ID = 8
Device Slave Addr = 0x54
Detectd sensor id0=14 id1=10
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
```

and user could run the Windows tool AMCAP2.exe to see the status.



If user would like to end the processing, close the tool AMCAP2.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
============================================================
```

Before selecting the item 3, user should connect USB cable between ByEZCam board. After setting the item 3, user will find the USB disk under Windows explorer. The UART log is shown as follows.

```
N3290 UDC Library (20150820)
Initial SD NonOS Driver (20160602 SD0_CD) for SD port 0
N3290 MSC Library (20151208)
MSC - SD Card detect pin is in use
```

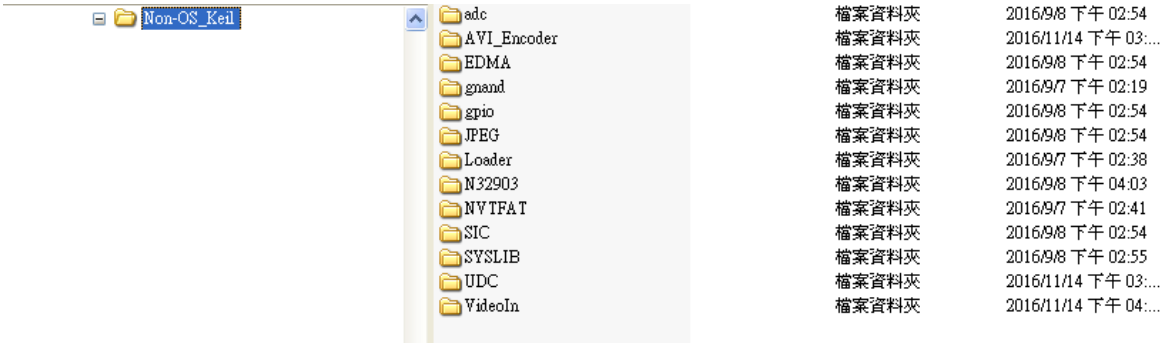
If user would like to end the process, plug USB cable out and UART log is shown as follows.

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

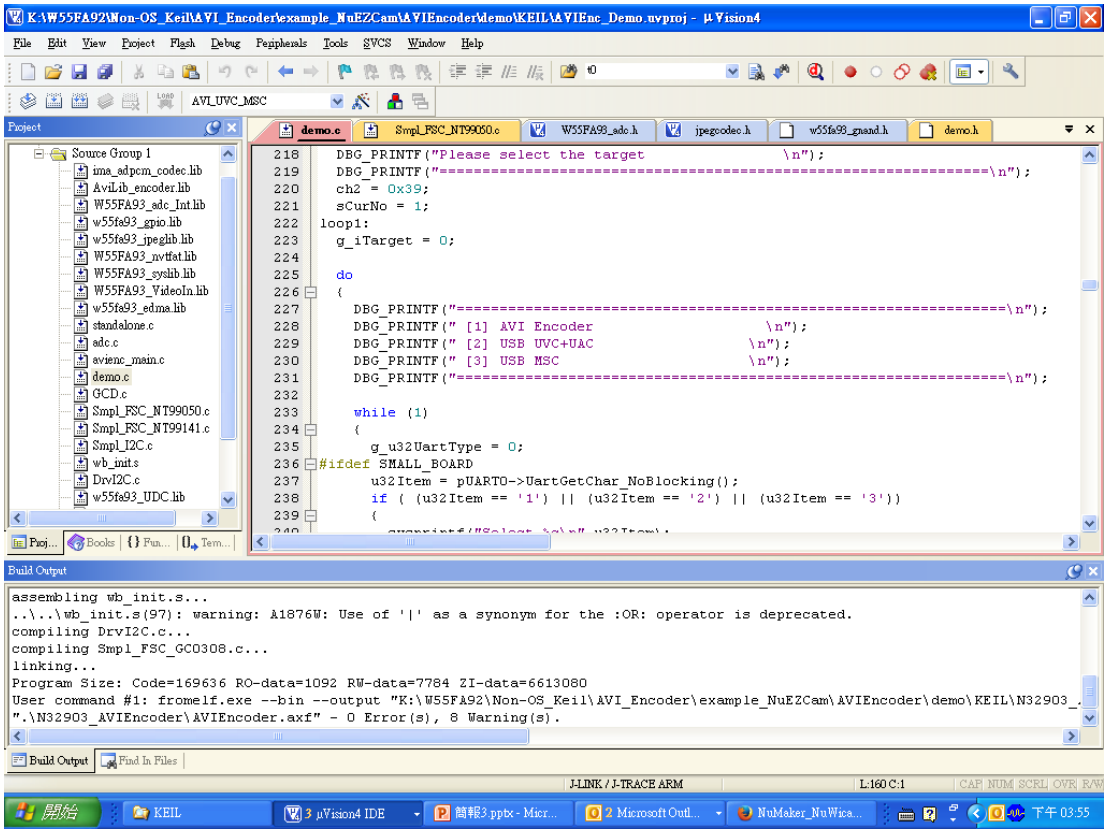
4 SOURCE CODE

The source code of AVI encoder has versions Keil. Currently the application runs under NuEZCam board, to support the sensor NT99141 (HD, 1280x720, 20 FPS), GC0308 (VGA, 30 FPS) and NT99050 (VGA, 30 FPS). N32903 has 8 MB, therefore the solution supports HD and VGA.

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



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



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

5 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.

6 REVISION HISTORY

Date	Revision	Description
2016.11.15	1.02	1. Use NuEZCam board and NuWicam debug board.
2016.09.13	1.01	1. Initially issued.

Important Notice

Nuvoton Products are neither intended nor warranted for usage in systems or equipment, any malfunction or failure of which may cause loss of human life, bodily injury or severe property damage. Such applications are deemed, "Insecure Usage".

Insecure usage includes, but is not limited to: equipment for surgical implementation, atomic energy control instruments, airplane or spaceship instruments, the control or operation of dynamic, brake or safety systems designed for vehicular use, traffic signal instruments, all types of safety devices, and other applications intended to support or sustain life.

All Insecure Usage shall be made at customer's risk, and in the event that third parties lay claims to Nuvoton as a result of customer's Insecure Usage, customer shall indemnify the damages and liabilities thus incurred by Nuvoton.