ARM® ARM926EJ-S

32-bit Microprocessor

NuMaker NuWicam Samples

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

www.nuvoton.com

Table of Contents

1 INTRODUCTION 3
1.1 Modbus RTU 3
1.2 Function testing 4
1.2.1 Using NuWicam player APP 4
1.2.2 Using PC utilities 4
2 ARDUINO UNO (OR NUMAKER UNO) BOARD 8
2.1 Board schematics 8
2.2 Requirement 9
2.2.1 Hardware 9
2.2.2 Software 9
2.3 Purchasing information 9
2.4 Arduino IDE installation 10
2.5 Sample code building 13
3 NUMAKER MEGA BOARD 16
3.1 Board schematics 16
3.2 Requirement 16
3.2.1 Hardware 16
3.2.2 Software 16
3.3 Purchasing information 16
3.4 Sample code building 17
4 NUMAKER-PFM-NUC472 BOARD 20
4.1 Board schematics 20
4.2 Requirement 20
4.2.1 Hardware 20
4.2.2 Software 20
4.3 Purchasing information 21
4.4 Sample code building 21
5 REVISION HISTORY 25

1 INTRODUCTION

In NuWicam samples, we use Modbus RTU protocol to communicate between mobile device and low-end MCUs. Modbus is often used to connect a supervisory computer with a remote terminal unit (RTU) in supervisory control and data acquisition (SCADA) systems.

In this document, we will descript how to construct the NuMaker NuWicam[1] samples. These samples include LEDs controlling, get temperature value from digital or analog sensor. These samples can be executed on Arduino(or NuMaker) UNO, NuMaker MEGA or NuMaker-PFM-NUC472 board. We will descript more details in sub-chapter as below.

- Arduino(or NuMaker) UNO board
- NuMaker MEGA with its Daughterboard
- NuMaker-PFM-NUC472 board

1.1 Modbus RTU

Modbus[2] is a serial communications protocol. It is simple, robust and now a commonly available means of connecting industrial electronic devices. Main reasons as below:

- Developed with applications in mind.
- Openly published and royalty-free.
- Easy to deploy and maintain.
- Moves raw bits or words without placing many restrictions on vendors.

In NuWicam application, our data mapping table is as below:

Register name	Address	Descript	Note
MB_InCounter	0x00	[R] Modbus query counter	
MB_OutCounter	0x01	[R] Modbus response counter	
MB_ErrorCounter	0x02	[R] Modbus error query counter	
BUTTON(DI)	0x03	[R] 4 button input value.	※
6-LED(DO)	0x04	[R/W] 6 LED output value.	
RGB(DO)	0x05	[R] RGB value.	※
7-Seqment Display(DO)	0x06	[R] 2-digit value.	※
Tempeture sesnor	0x07	[R] Temperature value.(degrees Celsius)	
(※): Only on NuMaker MEGA board is valid.			

[1] NuWicam is short for NuMaker NuWicam.

[2] More modbus details, please refer https://en.wikipedia.org/wiki/Modbus.

1.2 Function testing

1.2.1 Using NuWicam player APP

Open NuMaker NuWicam Player mobile APP to test function. As below figure, it shows a temperature value on the screen and these six circles are for every LED controllers. You can press these circles to light on/off LED. Current temperature information also is shown on 7-segment LEDs(Only on NuEdu M451 board).

Figure 1-1 NuWicam Player APP snapshot

1.2.2 Using PC utilities

1.2.2.1 Using VLC to get A/V stream

You can use VLC utility to get audio and video streams from NuWicam.

Press [Media], [Open Network Stream..] and input the network URL. The URL is '**rtsp://192.168.100.1:554/cam1/mpeg4'.** Then, press [Play] to play.

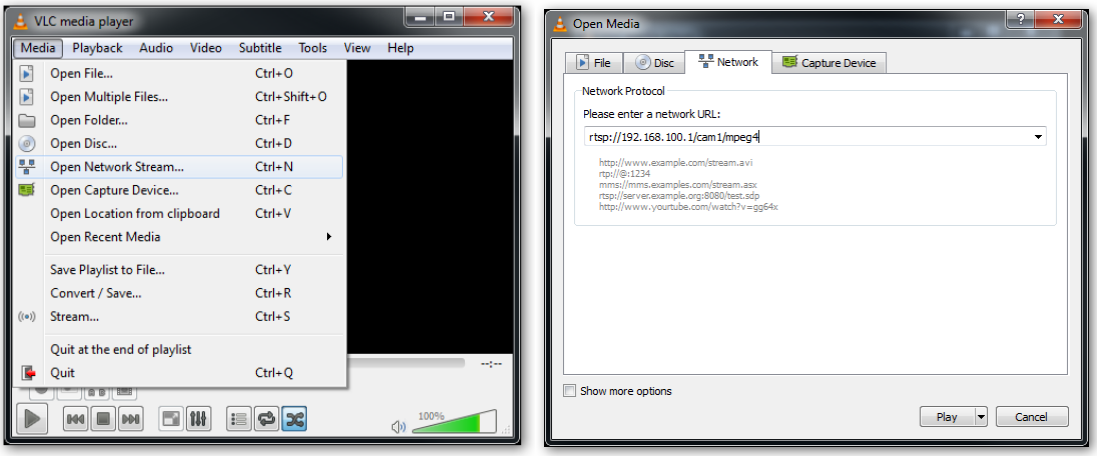


Figure 1-2 VLC configuration for NuWicam RTSP connection

1.2.2.2 *Using Modbus poll to poll data*

Connction setting - You can use 'Modpoll' utility to do Modbus communication beweet PC and NuMaker UNO (or mbed board). At first, In 'Connection Setup' page, select 'Modbus RTU/ASCII Over TCP/IP' item in 'Connection' combo list. In 'Mode' radio group, select RTU. In 'Response Timeout', input 1000 into 'Response Timeout' textedit and input 100 into 'Delay Between Polls' textedit. Finally, the IP address is '192.168.100.1' and 'Server Port' is 502. You also refer below Figure 1-3 to fill settings.

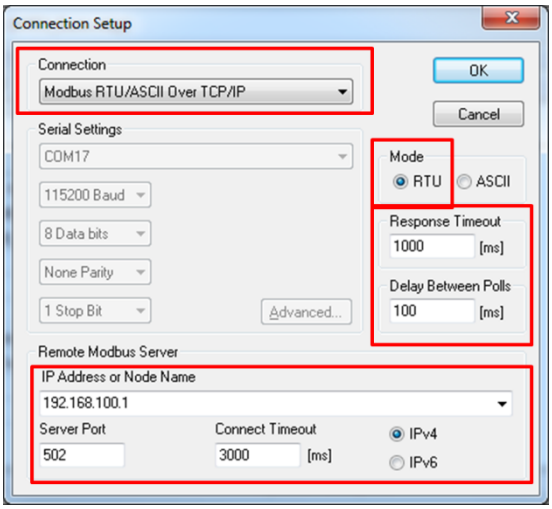


Figure 1-3 Modbus RTU Over TCP/IP connection

Data register polling - You can open '**Read-Write Definition**' to set modbus slave paramters. At first, input '1' into 'Slave ID' textedit, select '03 Read Holding Registers (4x)' in 'Function' combo list, input '0' into 'Address' textedit, input '8' into 'Quantity' textedit and input '500' into 'Scan Rate' textedit. Finally, press 'OK' to start polling data. You also refer below Figure 1-4 to fill settings.

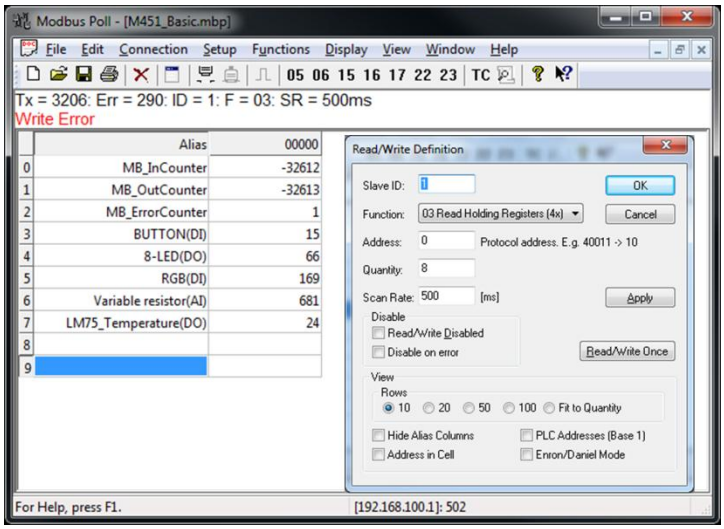


Figure 1-4 Modbus register Read/Writer setting for NuWicam sample

Data traffic monitor - You can open 'Communication Traffic' of 'Modbus poll' to analysis data traffic and also open Wireshark to analysis TCP data between NuWicam and PC.

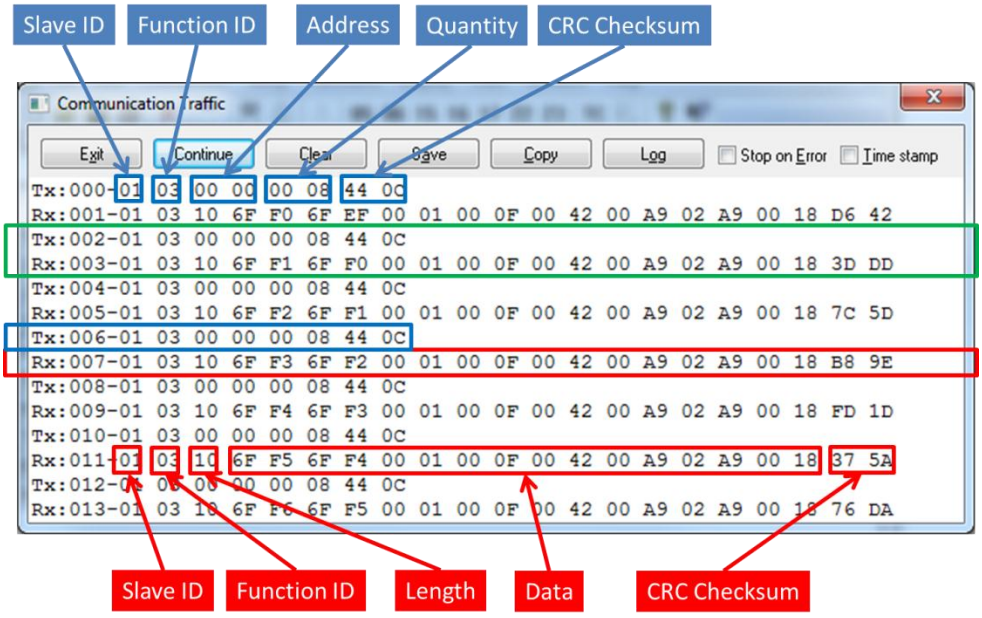


Figure 1-5 Modbus protocol communication traffic between master and slave

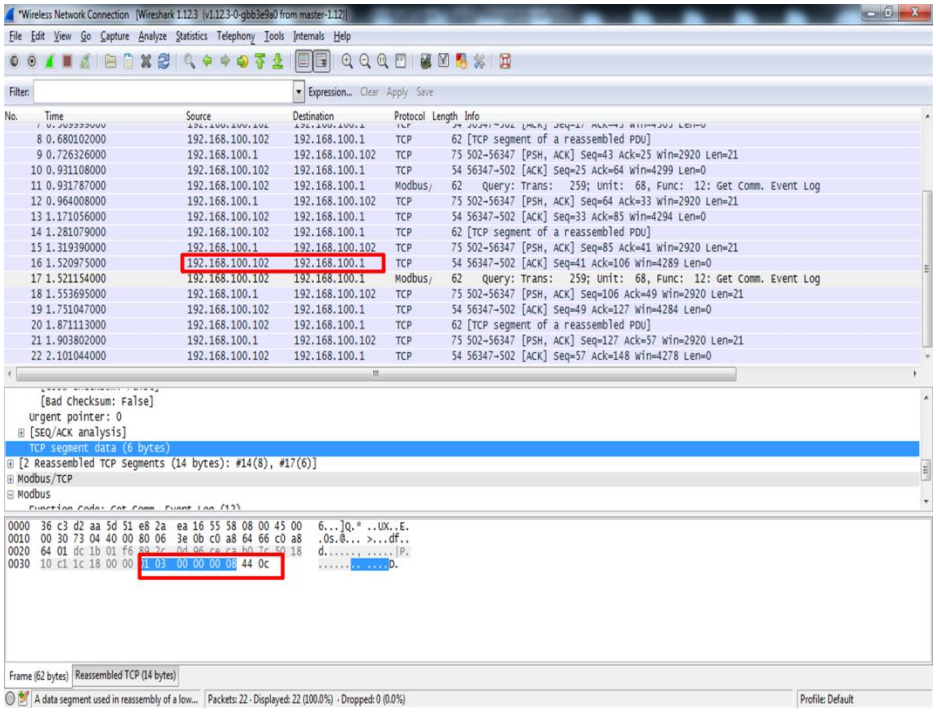


Figure 1-6 TCP data traffic using Wireshark – Modbus master TX data

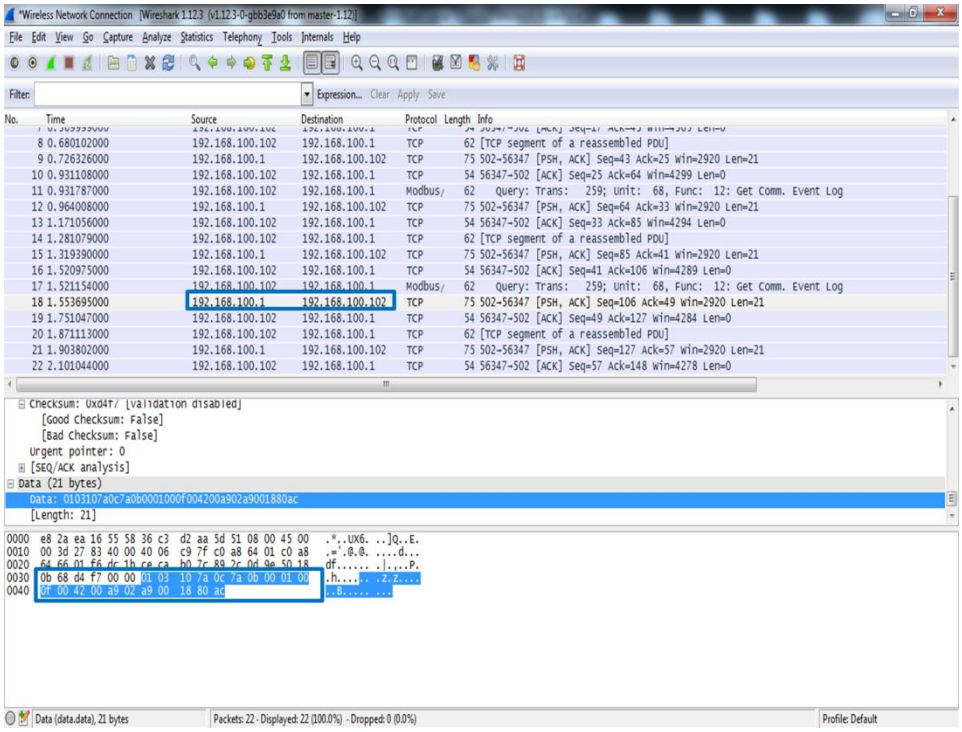


Figure 1-7 TCP data traffic using Wireshark – Modbus master RX data

2 ARDUINO UNO (OR NUMAKER UNO) BOARD

2.1 Board schematics

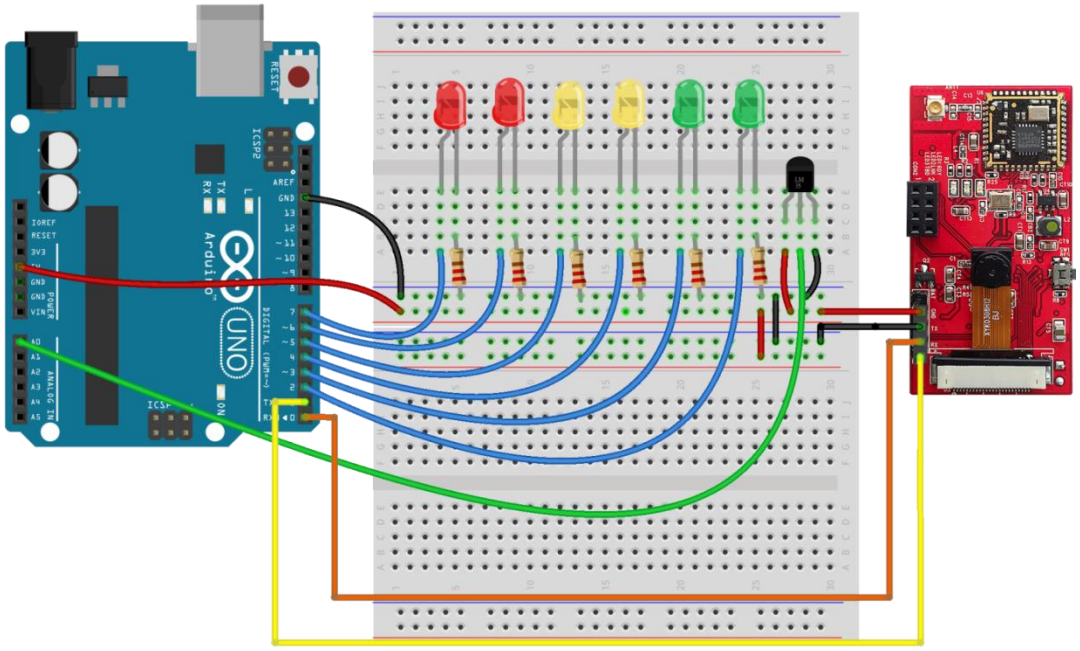


Figure 2-1 NuWicam-VGA board with Arduino UNO

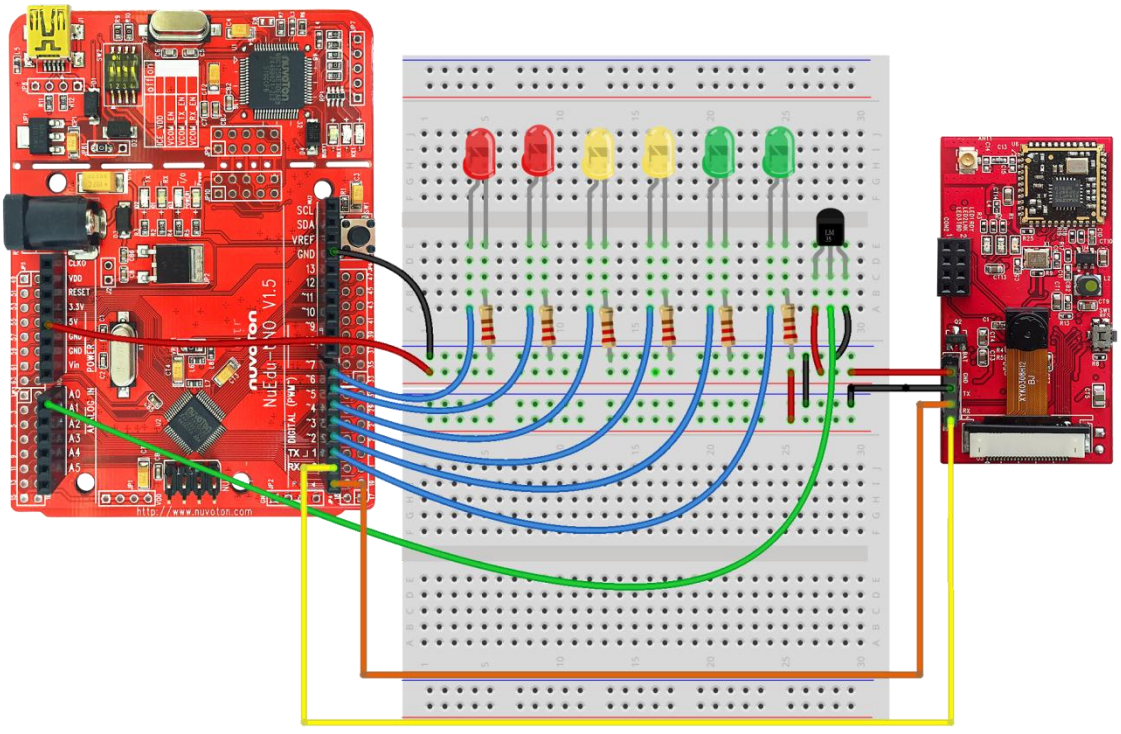


Figure 2-2 NuWicam-VGA board with NuMaker UNO

2.2 Requirement

2.2.1 Hardware

- NuWicam board with firmware x 1
- Geduino UNO(or NuMaker UNO) board x 1 (with USB Line, DC Power adapter)
  - **If your board is NuMaker UNO, please remember to switch 2, 3 and 4 of SW2 to 'OFF' on the board.**
- Red LEDs x 2, Green LEDs x 2 and Blue LEDs x 2
- 220 ohm resistor x 6
- Some dupont lines
- LM35 analog temperature sensor
- USB power adapter(5V/1A).

2.2.2 Software

- Arduino IDE v1.6.9 (or later)
  - You can refer the page to install arduino IDE for NuEdu-UNO. https://github.com/OpenNuvoton/NuEdu-UNO
- Modified Modbus-Master-Slave-for-Arduino Modbus library
  - Please download library on github server.
  - Path: https://github.com/OpenNuvoton/NuMaker_NuWicam_Samples/NuMaker_NuWiCam_Arduino_UNO/Modbus-Master-Slave-for-Arduino.zip
- NuWicam sample code for Arduino UNO/Mega board.
  - Please download source on github server.
  - Path: https://github.com/OpenNuvoton/NuMaker_NuWicam_Samples/NuMaker_NuWiCam_Arduino_UNO

2.3 Purchasing information

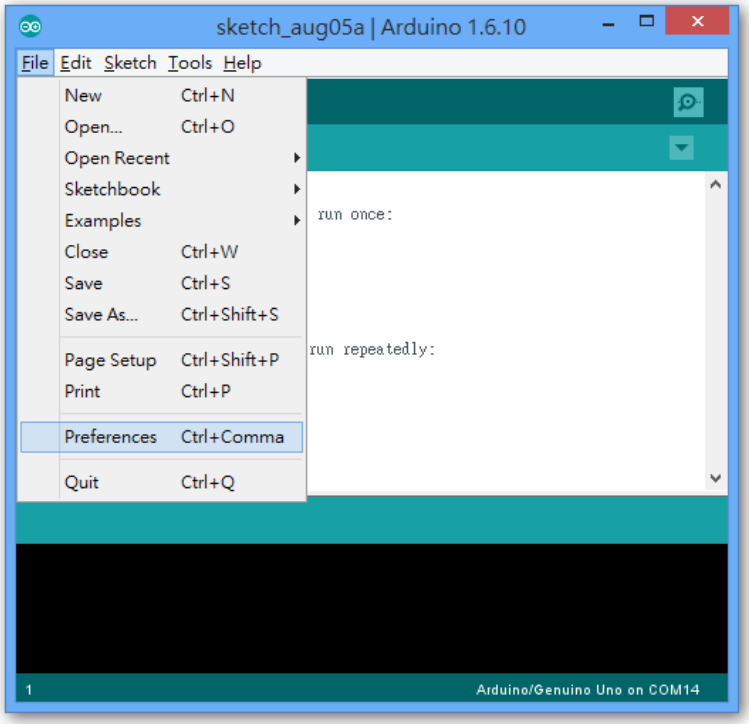
- **NuMaker UNO board**
  URL: https://world.tmall.com/item/523268526584.htm?spm=a312a.7700824.w4011-6765047385.25.2qjfiz&id=523268526584&rn=93873a1038dd4952f86ee4c2766ccae0&abbucket=10
- **LM35 analog temperature sensor module**
  URL: https://world.taobao.com

2.4 Arduino IDE installation

Step 1: Download Arduino 1.6.10 IDE from https://www.arduino.cc/en/Main/Software

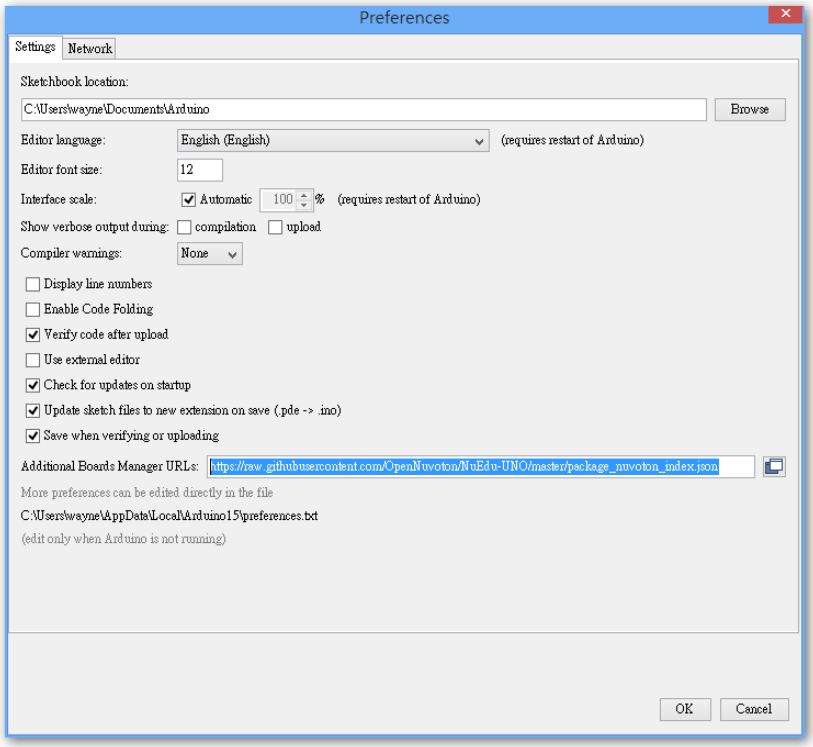
Step 2: Extract arduino-1.6.10-windows.zip to c:\arduino-1.6.10.

Step 3: Double-click arduino.exe, and then go to File->Preferences.

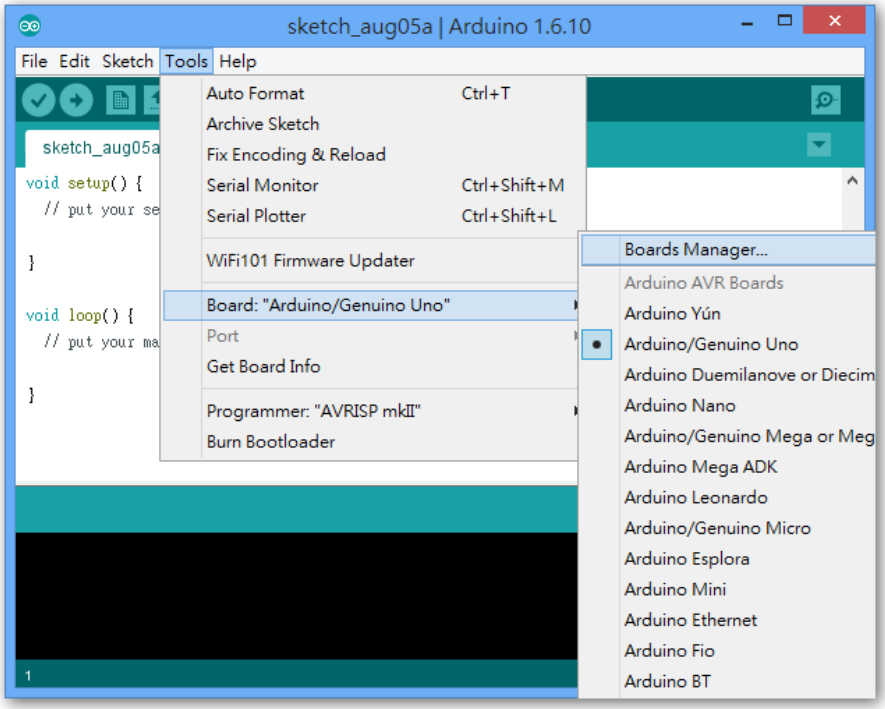


Step 4: Paste following URL to 'Additional Boards Manager URLs' input field:

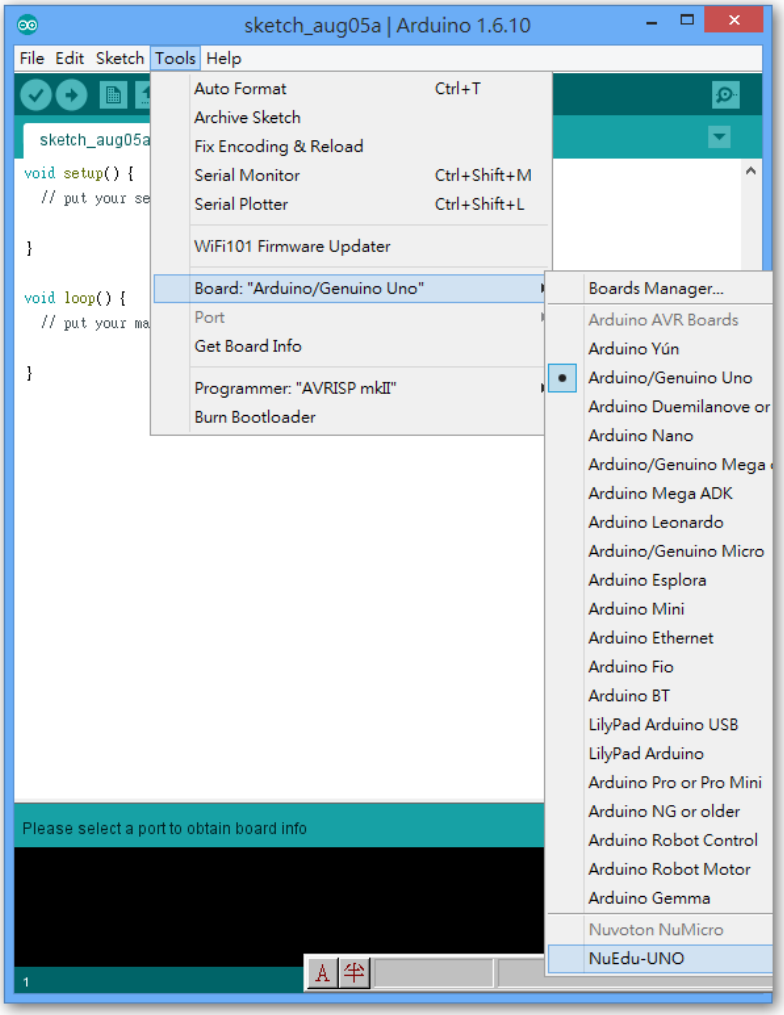
https://raw.githubusercontent.com/OpenNuvoton/NuEdu-UNO/master/package_nuvoton_index.json



Step 5: Under Tools->Board->Boards Manger, search NuEdu-UNO by Nuvoton, click Install



Step 6: You can select NuEdu-UNO in Arduino IDE now.

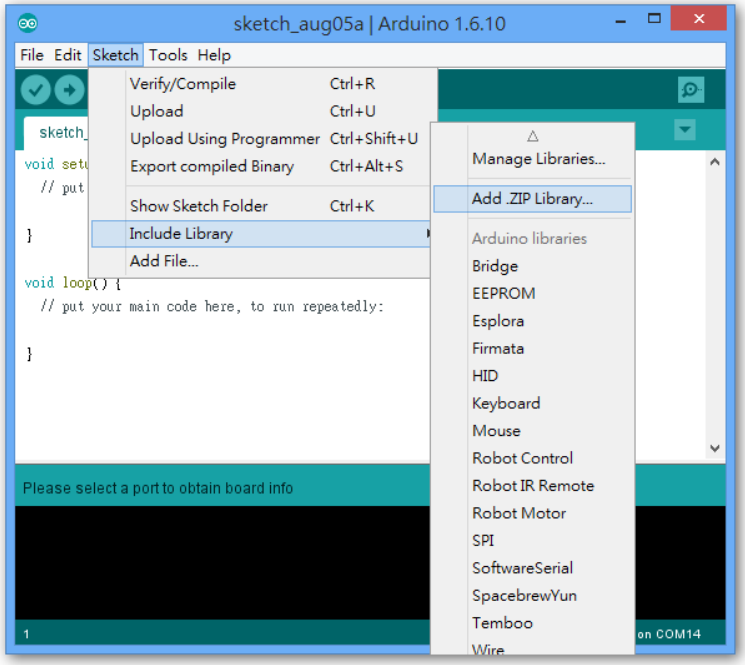


2.5 Sample code building

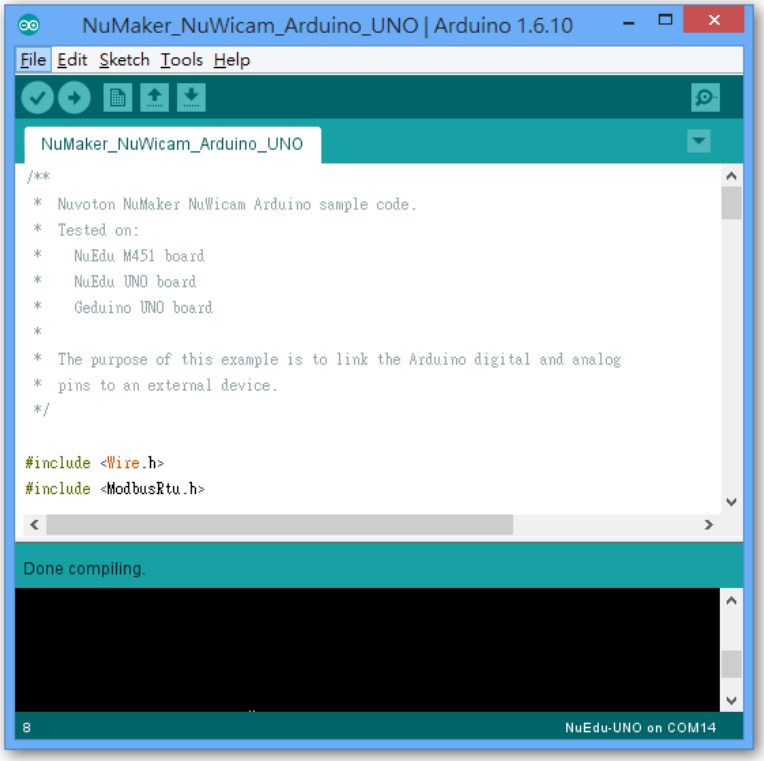
Please follow below steps to build executable binary.

Step 1: Import the modified Modbus-Master-Slave-for-Arduino Modbus.zip library

<Sketch> → <Include Library> → <Add .ZIP library …>→ Select the .zip file path. **→ <Open>**

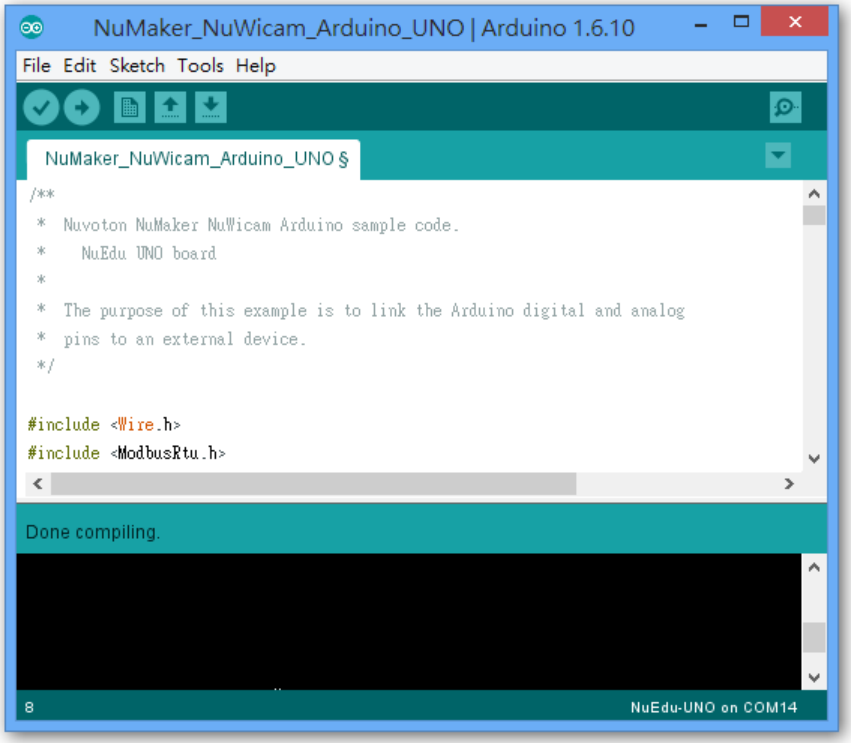


Step 2: Load NuWicam sample code for Arduino UNO board.



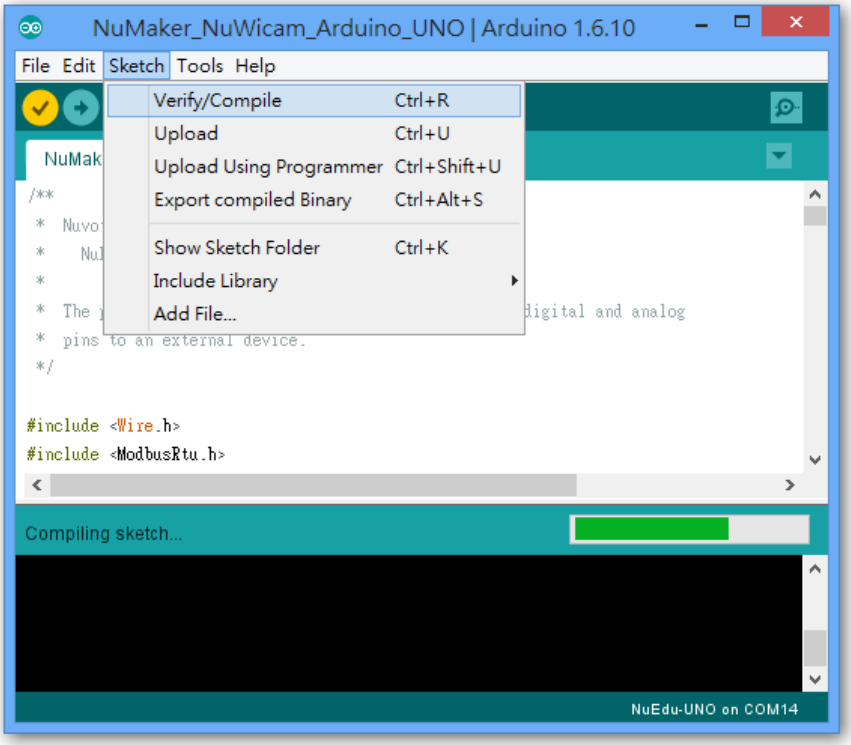
Step 3: Select configuration for Geduino UNO board.

<Tools> → <Board: "Arduino/Geduino UNO"> → Select Arduino/Geduino UNO.



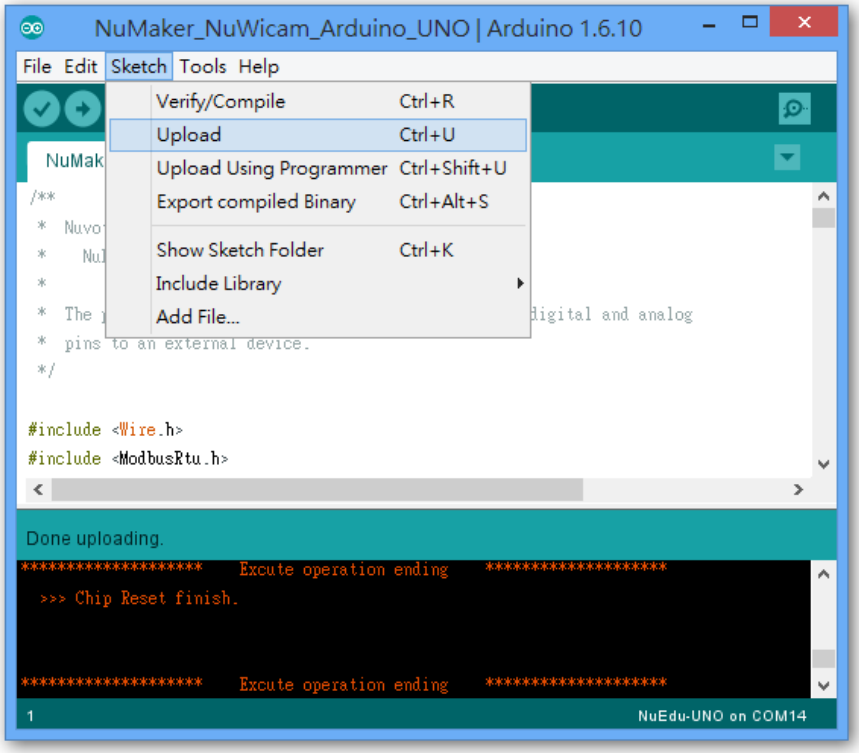
Step 4: Build sample code.

<Sketch> → <Verify/Compile>



Step 5: Upload executable binary to board.

<Sketch> → <Upload>



3 NUMAKER MEGA BOARD

3.1 Board schematics

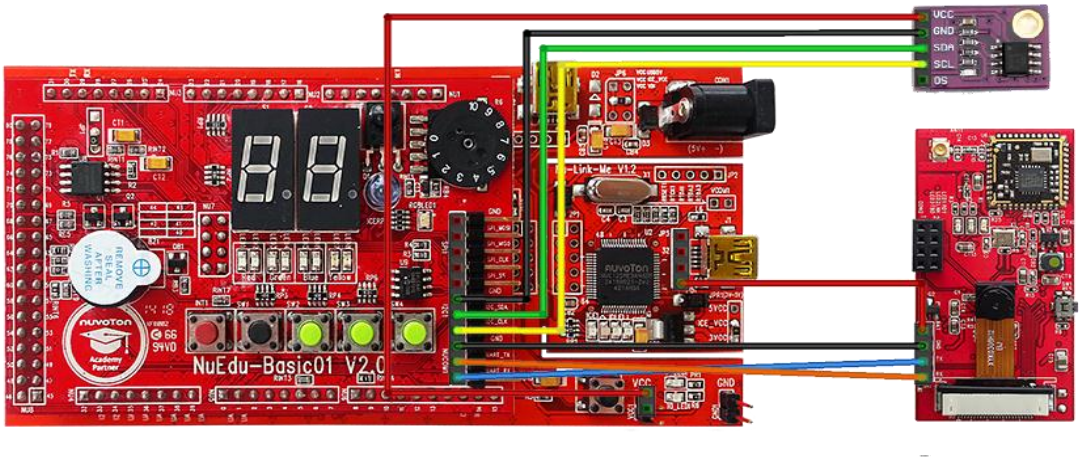


Figure 3-1 NuWicam-VGA board with NuMaker MEGA and its daughter board

3.2 Requirement

3.2.1 Hardware

- NuWicam board with firmware x 1
- NuMaker MEGA board x 1 (with USB Line, and NuEdu basic board)
- TI LM75a temperature sensor module board.
- Some dupont lines
- USB power adapter(5V/1A).

3.2.2 Software

- Arduino IDE v1.5.8 (**Must**)
  - Download path: https://www.arduino.cc/en/Main/OldSoftwareReleases#previous
- NuWicam sample code and patch files for NuMaker MEGA board.
  - Path: https://github.com/OpenNuvoton/NuMaker_NuWicam_Samples/NuMaker_NuWiCam_Nuduino/numaker_nuwicam_arduino_1.5.8_patch.exe

3.3 Purchasing information

- NuMaker MEGA board x1
  If you need to NuMaker MEGA board, we provide purchasing information for you. About more information, please visit the Nuvoton on-line store on Tmall(天貓).

URL: https://world.tmall.com/item/43127043123.htm?spm=a312a.7700824.w4011-6765047385.25.Usfy8Y&id=43127043123&rn=7b5af4061de8905a6de7032ec4af54a8&abbucket=3

- TI LM75a temperature sensor module board
  URL:https://world.taobao.com/item/534877355522.htm?spm=a312a.7700714.0.0.Z5guaZ#detail

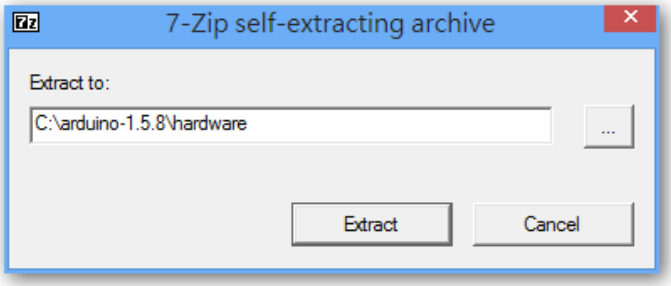
  Notice: Please remember to short A0, A1 and A2 switch to GND.

3.4 Sample code building

Please follow below steps to build executable binary.

Step 1: Install NuWicam patch files for NuMaker MEGA board

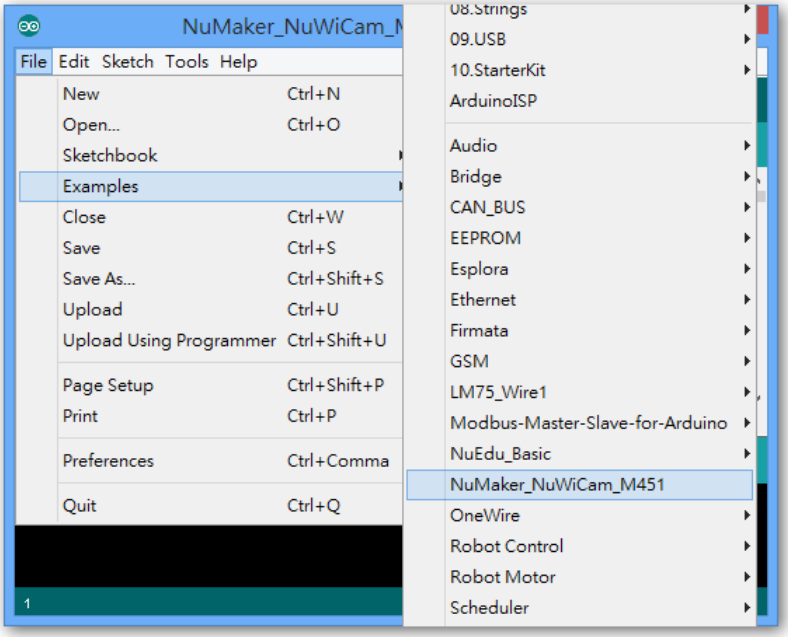
You should specify the arduino-1.5.8 IDE installation path. For example, the arduino-1.5.8 IDE installation path is 'C:\arduino-1.5.8'. You need extract files into **'C:\arduino-1.5.8\hardware'**.



Step 2: Load NuWicam sample code for NuMaker MEGA board.

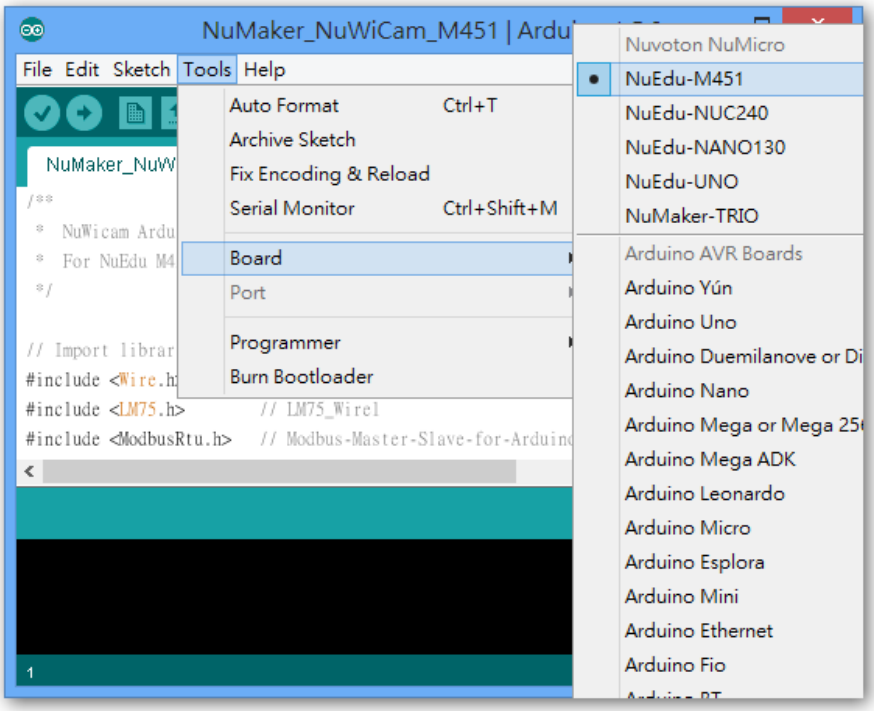
To execute C:\arduino-1.5.8\arduino.exe and Load NuWicam sample code.

<File> → <Examples> →<NuMaker_NuWicam_M451>.



Step 3: Select configuration for NuMaker MEGA board.

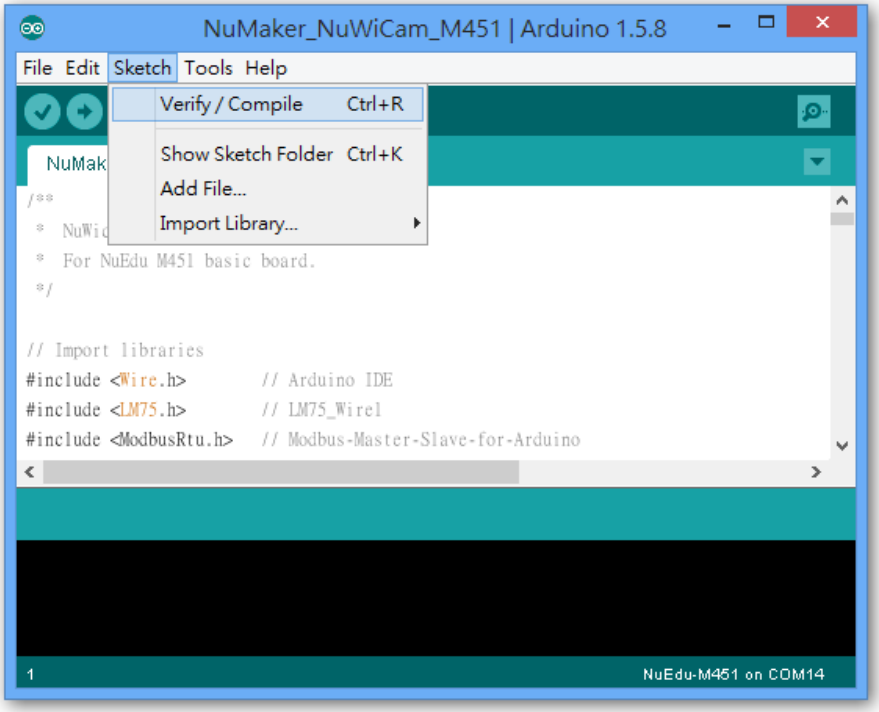
<Tools> → <Board: "NuEdu/M451"> → Select NuEdu-M451.



Step 4: Build sample code.

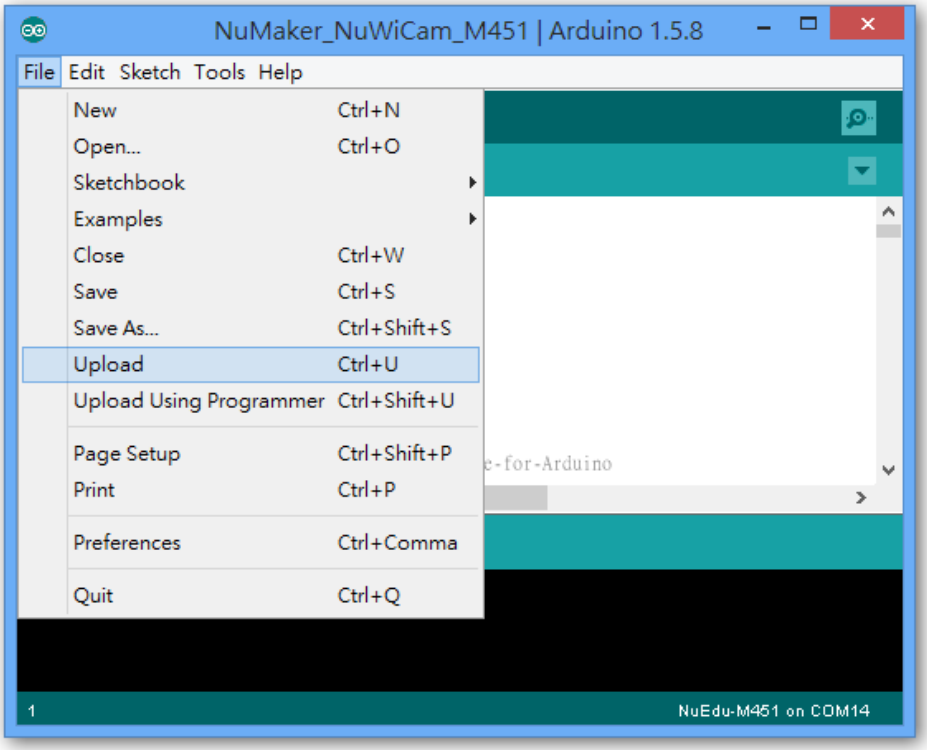
<Sketch> → <Verify/Compile>

Notice: The NuWicam patch for NuMaker MEGA already includes modified MODBUS library. You should remove Modbus-Master-Slave-for-Arduino Modbus library if necessary.



Step 5: Upload executable binary to board.

<File> → <Upload>



4 NUMAKER-PFM-NUC472 BOARD

4.1 Board schematics

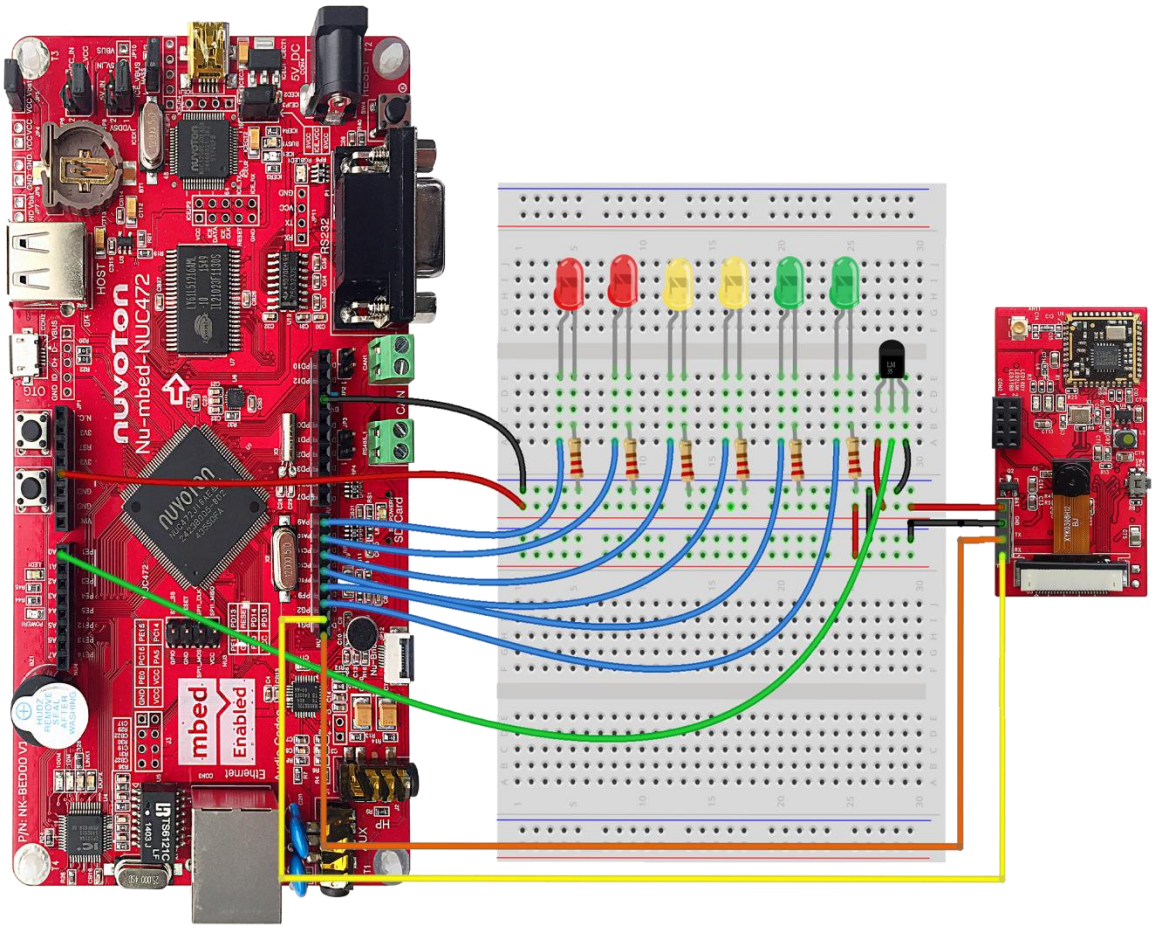


Figure 4-1 NuWicam-VGA board with NuMaker-FPM-NUC472 board

4.2 Requirement

4.2.1 Hardware

- NuWicam board with firmware x 1
- NuMaker-FPM-NUC472 board x 1 (with USB Line, DC Power adapter)
- Red LEDs x 2, Green LEDs x 2 and Blue LEDs x 2
- 220 ohm resistor x 6
- Some dupont lines
- LM35 analog temperature sensor
- USB power adapter(5V/1A).

4.2.2 Software

- Google Chrome Browser
- NuWicam sample code for NuMaker-FPM-NUC472 board.
  - Please visit ARM website.
  - Path: https://developer.mbed.org/users/wclin/code/NuMaker_NuWicam_Lite/

4.3 Purchasing information

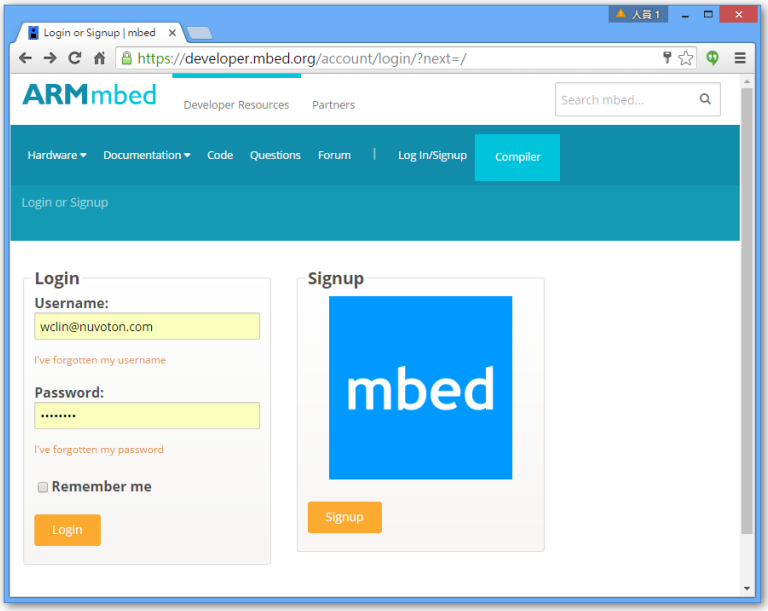
- **NuMaker-FPM-NUC472 board**
  URL: N/A
- **LM35 analog temperature sensor module**
  URL: https://world.taobao.com

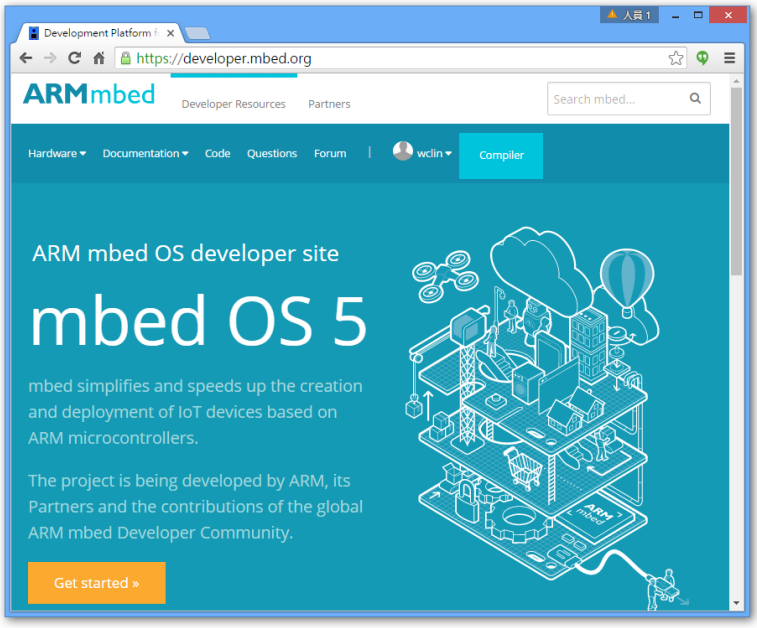
4.4 Sample code building

Please follow below steps to build executable binary.

Step 1: Open Google Chrome web browser and Login your ARM mbed account.

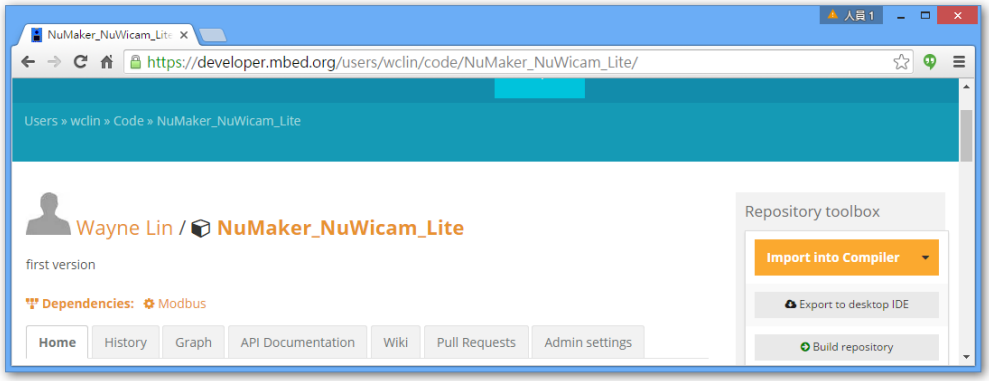
Path: https://developer.mbed.org/

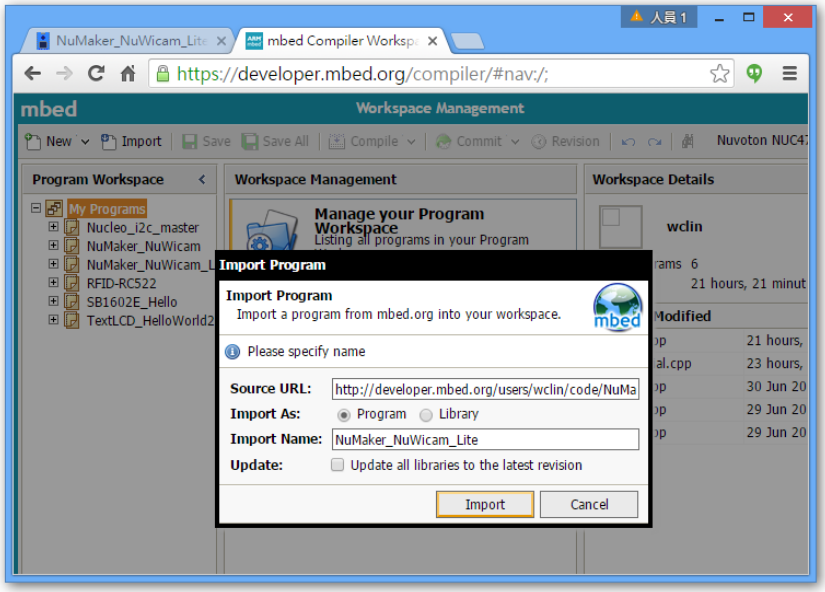


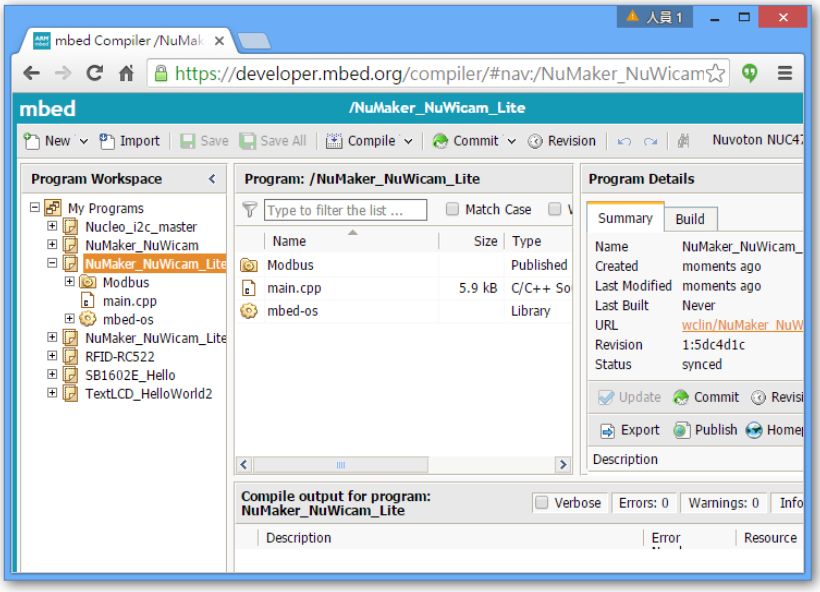


Step 2: Import NuWicam sample into 'ARM mbed Compiler'.

Path: https://developer.mbed.org/users/wclin/code/NuMaker_NuWicam_Lite/
Press **<Import into Compiler>** button, it will import the program.

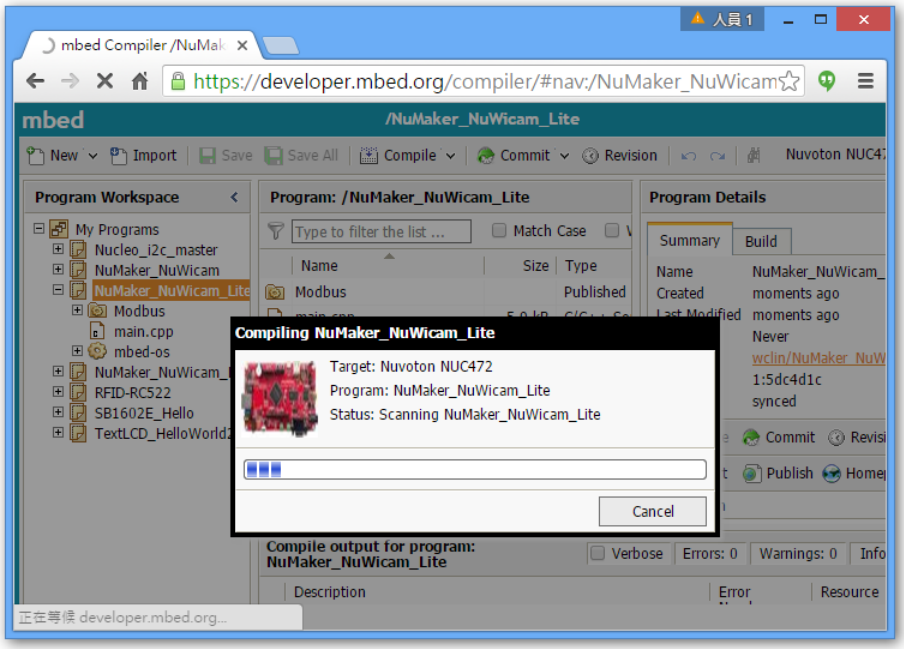


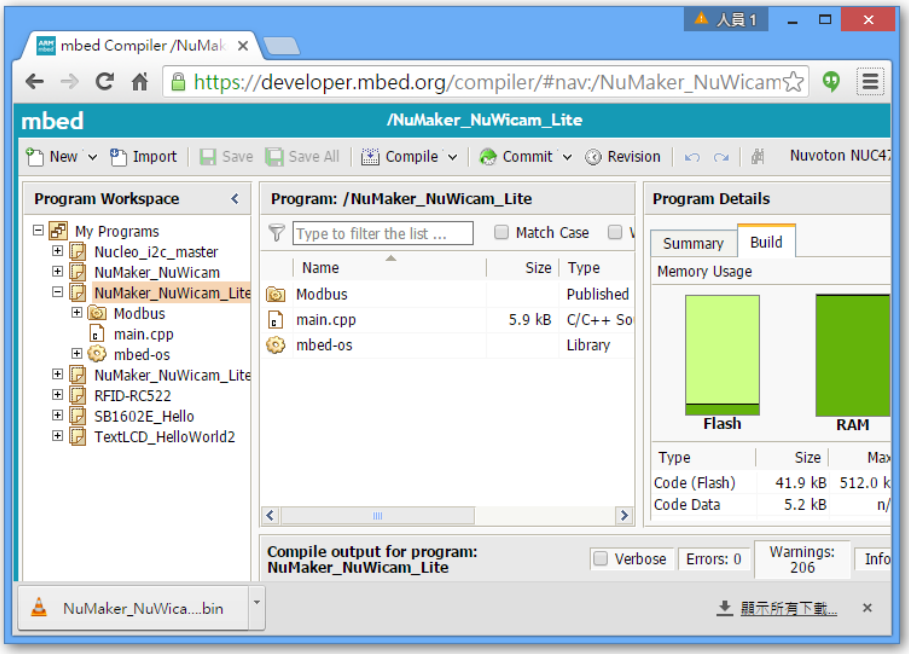




Step 3: Build sample code

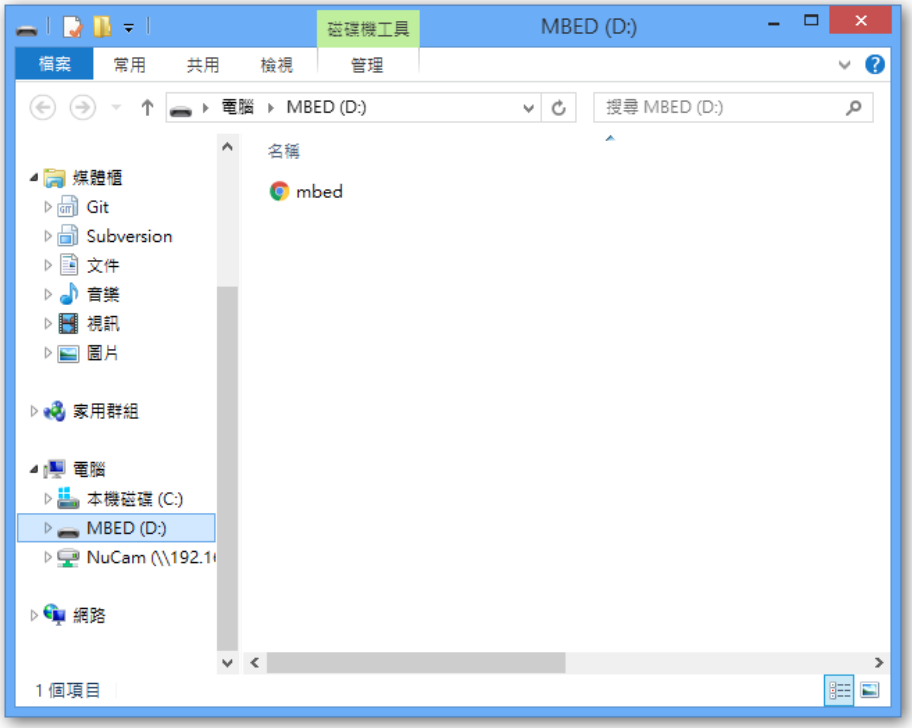
Press **<Compile>** to build the sample code. After done, it will produce downloadable file.

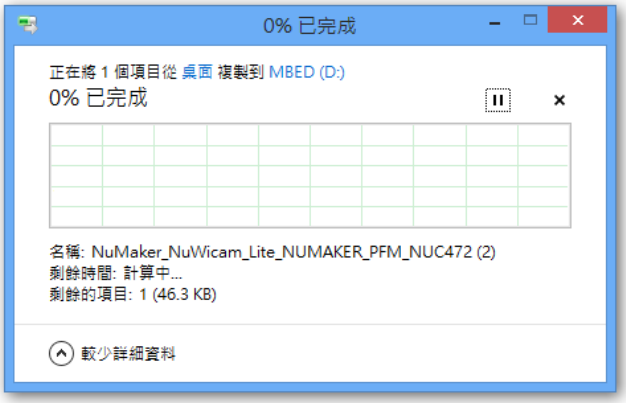




Step 4: Upload executable binary to board.

Copy the **'NuMaker_NuWicam_Lite_NUMAKER_PFM_NUC472.bin'** to mbed disk. You can find the mbed disk in your computer manager.





5 REVISION HISTORY

Date	Revision	Description
2016.08.10	1.00	1. Initially issued.
2016.08.17	1.01	2. Modify Nuduino to NuMaker UNO
2016.08.31	1.02	3. Add some testing utilities description for window platform.

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.