ARM® ARM926EJ-S

32-bit Microprocessor

NuMaker NuWicam Samples

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

www.nuvoton.com

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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 Nuduino) UNO, Nuduino MEGA or Nubed board. We will descript more details in sub-chapter as below.

- Arduino(or Nuduino) UNO board
- Nuduino MEGA with its Daughterboard
- Nubed 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] RGB value.	※
Tempeture sesnor	0x07	[R] Temperature value.(degrees Celsius)	
(※): Only on Nuduino 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

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).

2 ARDUINO UNO (OR NUDUINO UNO) BOARD

2.1 Board schematics

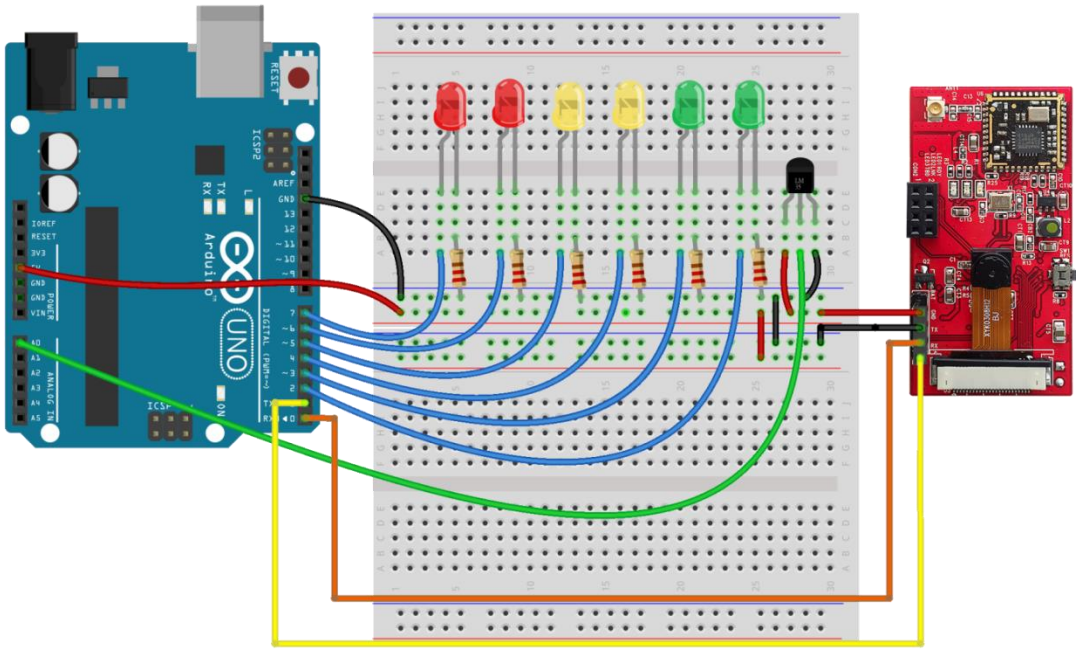


Figure 2-1 NuWicam-VGA board with Arduino UNO

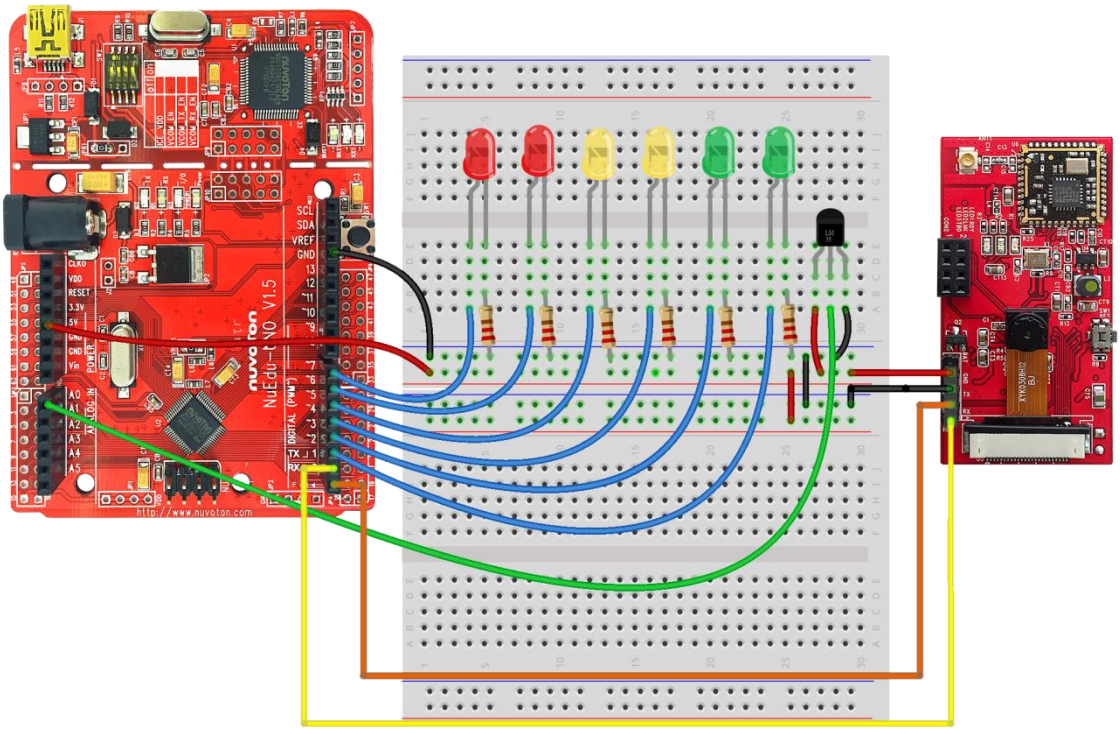


Figure 2-2 NuWicam-VGA board with Nuduino UNO

2.2 Requirement

2.2.1 Hardware

- NuWicam board with firmware x 1
- Geduino UNO(or Nuduino UNO) board x 1 (with USB Line, DC Power adapter)
  - **If your board is Nuduino 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

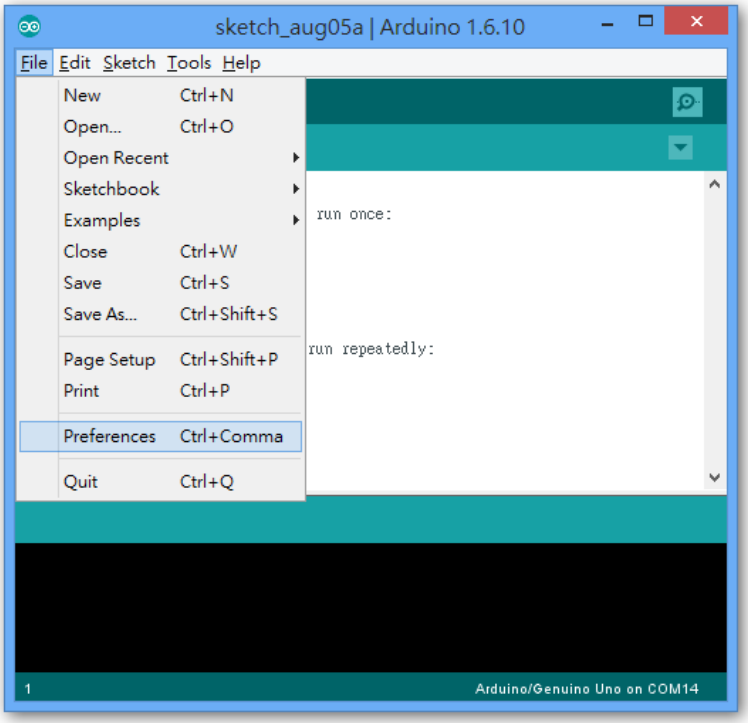
- **Nuduino UNO board**
  URL: https://world.tmall.com/item/523268526584.htm?spm=a312a.7700824.w4011-6765047385.25.2qjfiz&id=523268526584&rn=93873a1038dd4952f86ee4c2766ccae0&abbucket=10
- **LM35 analog temperature sensor module**
  URL: https://world.taobao.com

2.4 Arduino IDE installation

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

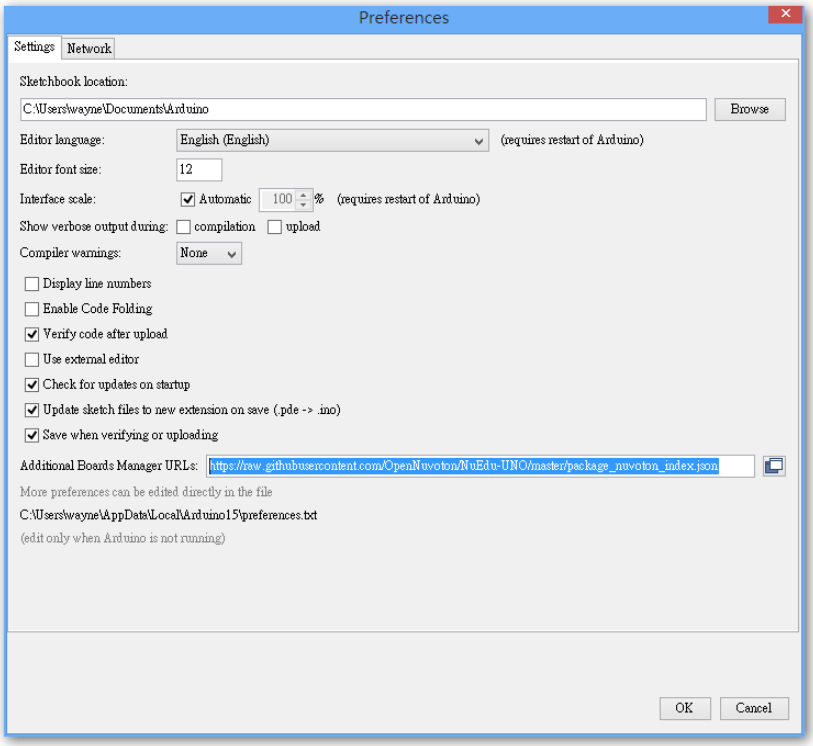
Step 2: Extract arduino-1.6.10-windows.zip to c:\arduino-1.6.10.

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

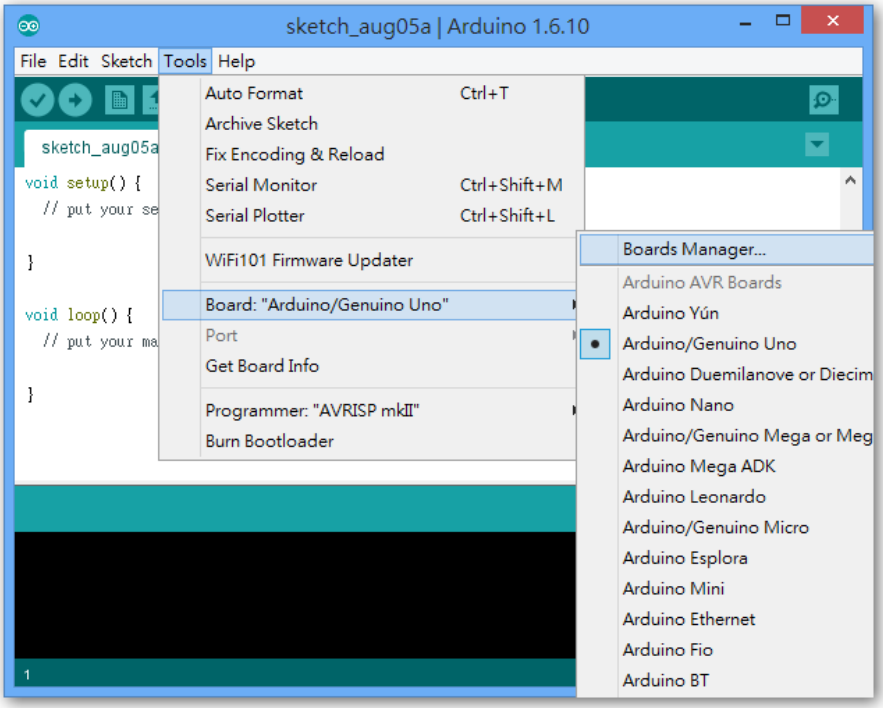


Step 4: Paste following URL to 'Additional Boards Manager URLs' input field:

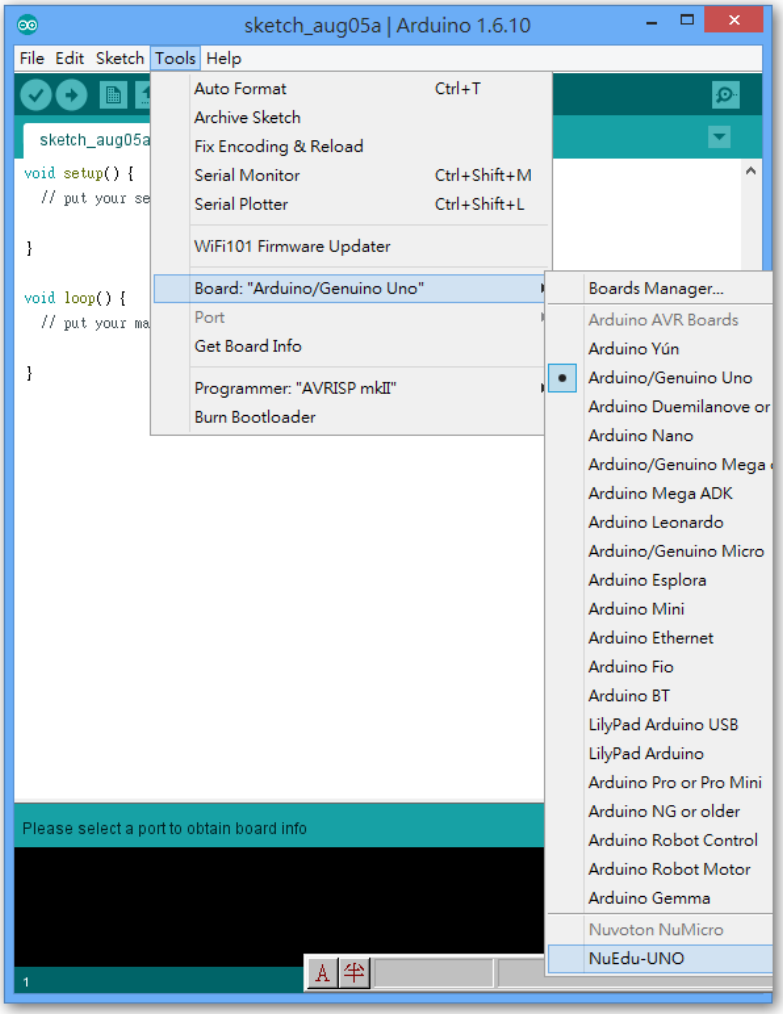
https://raw.githubusercontent.com/OpenNuvoton/NuEdu-UNO/master/package_nuvoton_index.json



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.

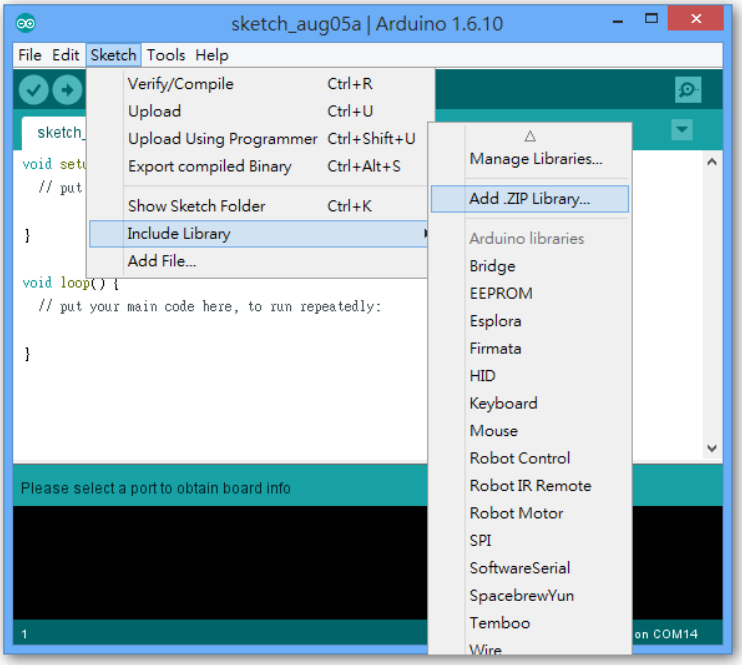


2.5 Sample code building

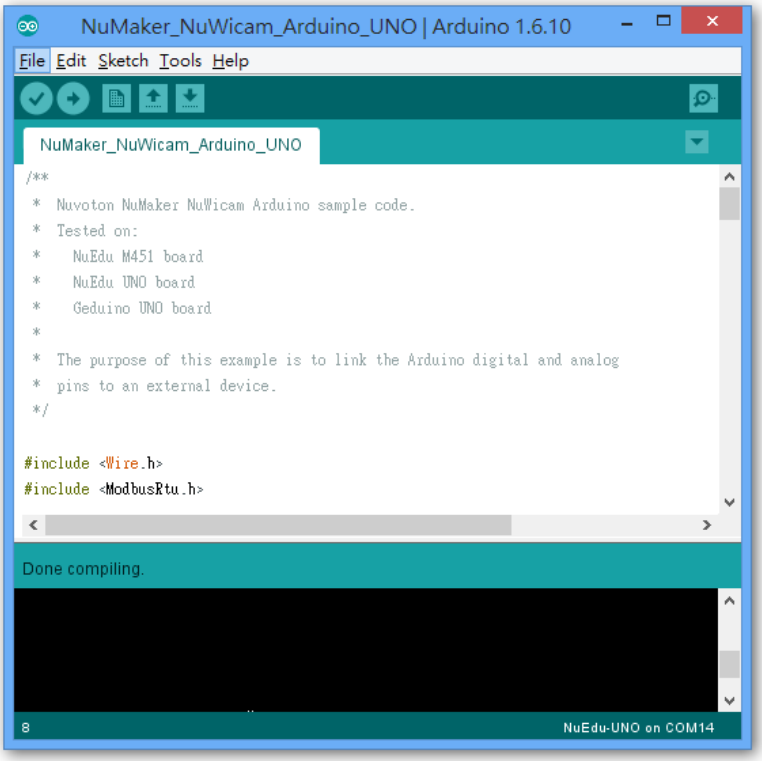
Please follow below steps to build executable binary.

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>**

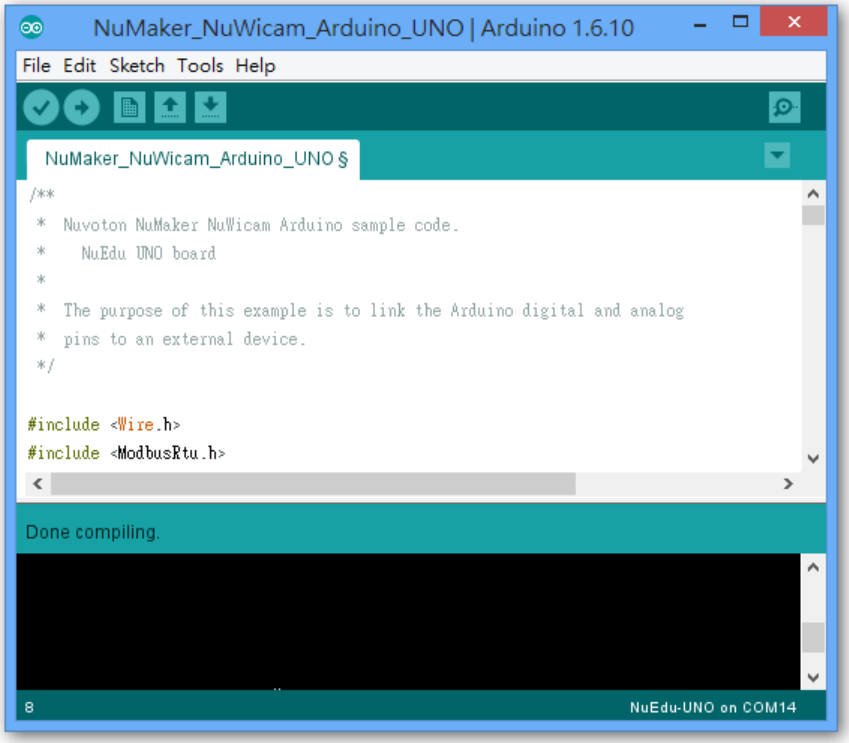


Step 2: Load NuWicam sample code for Arduino UNO board.



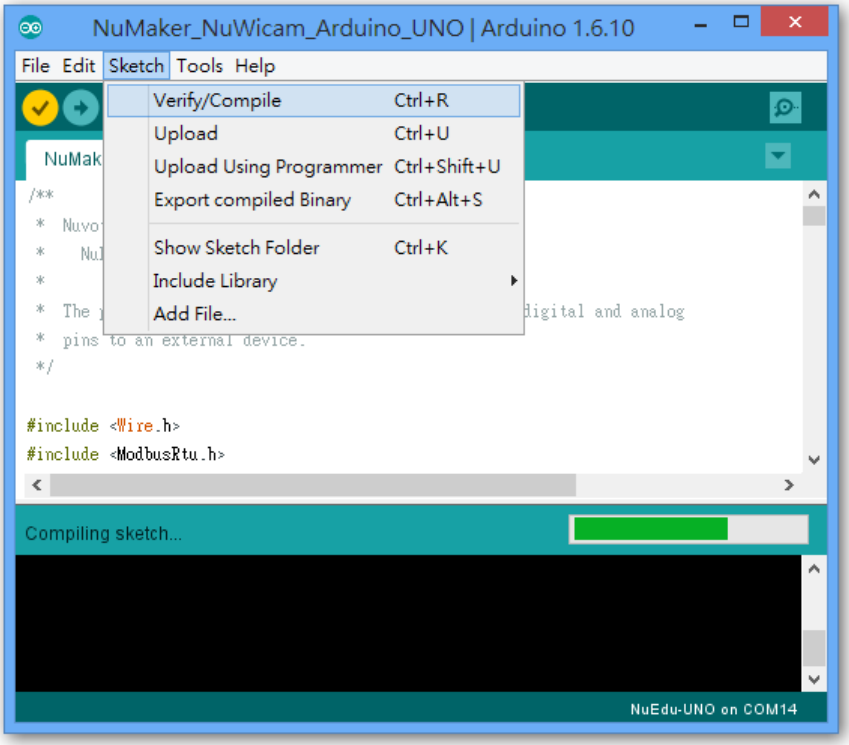
Step 3: Select configuration for Geduino UNO board.

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



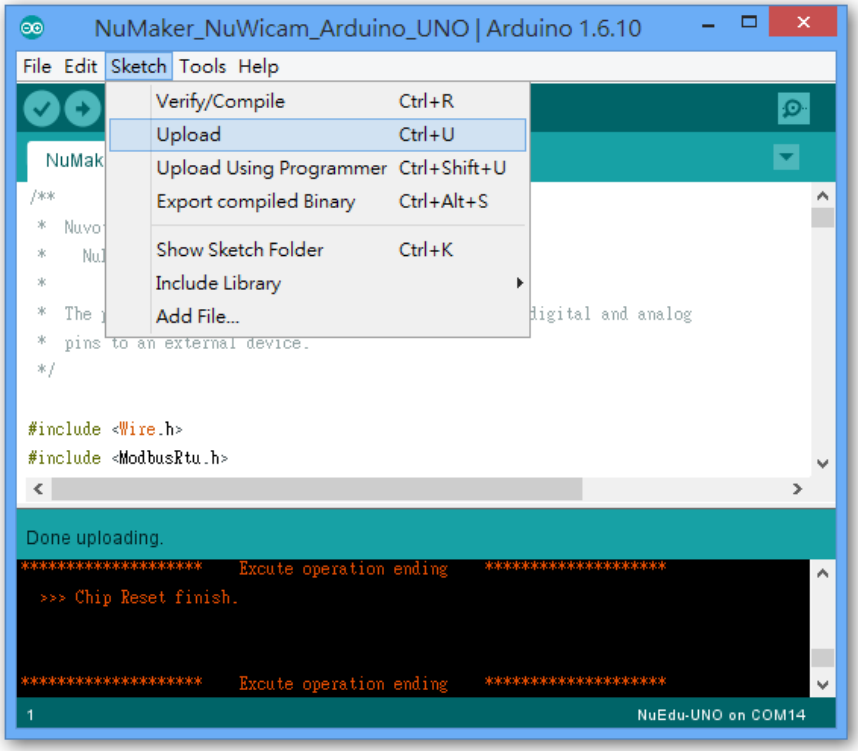
Step 4: Build sample code.

<Sketch> → <Verify/Compile>



Step 5: Upload executable binary to board.

<Sketch> → <Upload>



3 NUDUINO MEGA BOARD

3.1 Board schematics

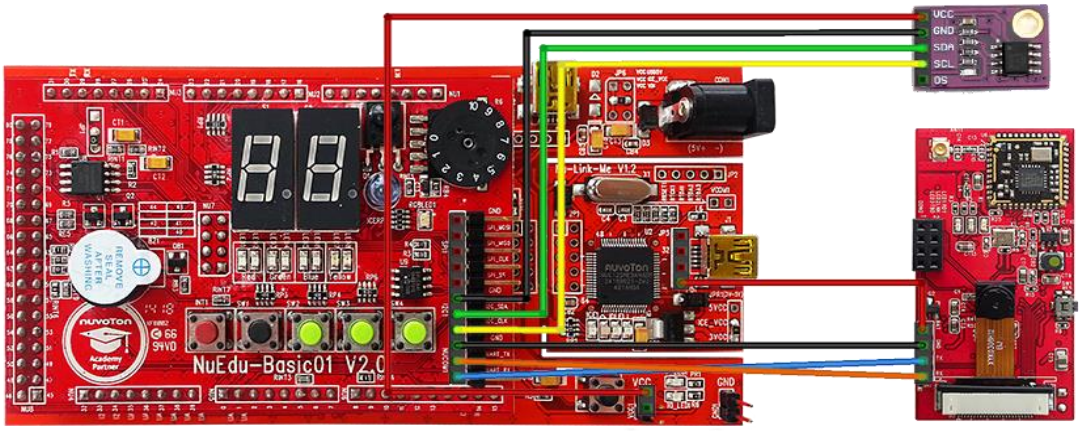


Figure 3-1 NuWicam-VGA board with Nuduino MEGA and its daughter board

3.2 Requirement

3.2.1 Hardware

- NuWicam board with firmware x 1
- Nuduino 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 Nuduino board.
  - Path: https://github.com/OpenNuvoton/NuMaker_NuWicam_Samples/NuMaker_NuWiCam_Nuduino/numaker_nuwicam_arduino_1.5.8_patch.exe

3.3 Purchasing information

- Nuduino board x1
  If you need to Nuduino 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

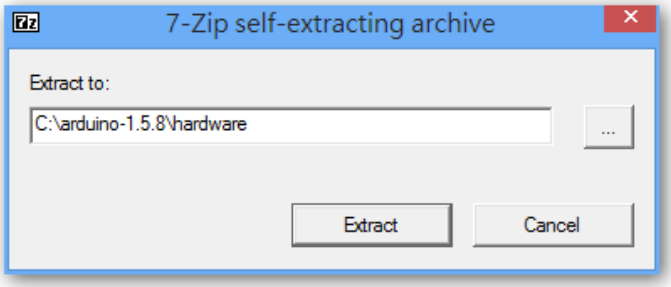
  Notice: Please remember to short A0, A1 and A2 switch to GND.

3.4 Sample code building

Please follow below steps to build executable binary.

Step 1: Install NuWicam patch files for Nuduino board

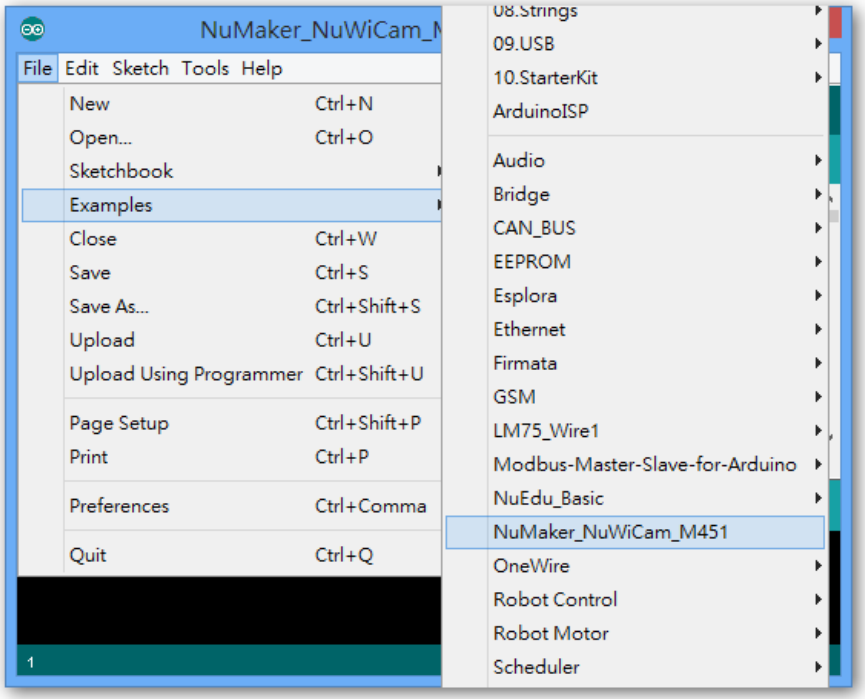
You should specify the arduino-1.5.8 IDE installation path. For example, the arduino-1.5.8 IDE installation path is 'C:\arduino-1.5.8'. You need extract files into **'C:\arduino-1.5.8\hardware'**.



Step 2: Load NuWicam sample code for Nuduino board.

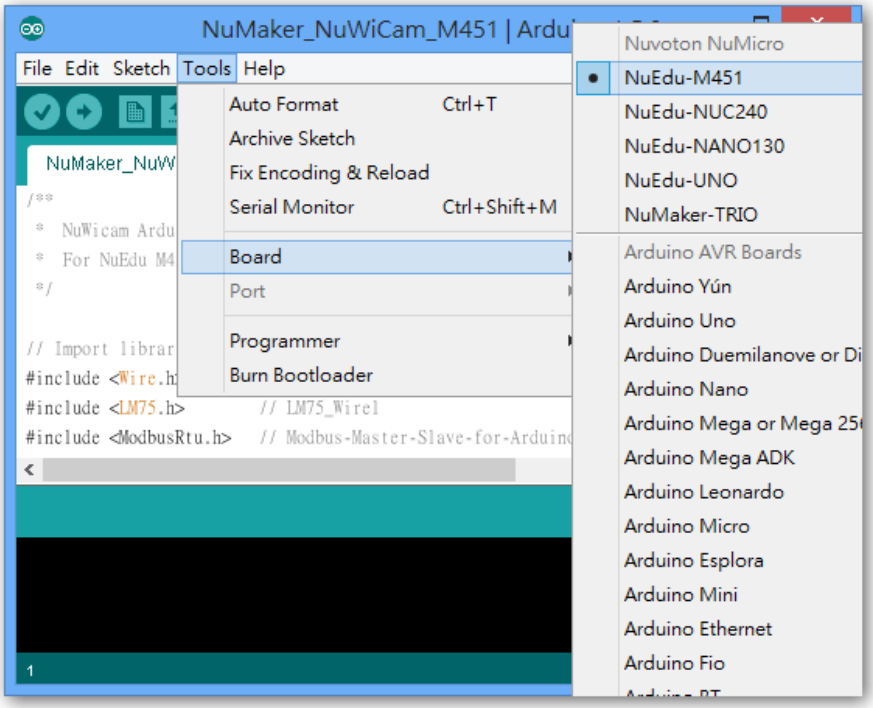
To execute C:\arduino-1.5.8\arduino.exe and Load NuWicam sample code.

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


NuMaker_NuWiCam_M
File Edit Sketch Tools Help
New Ctrl+N
Open... Ctrl+O
Sketchbook
Examples
Close Ctrl+W
Save Ctrl+S
Save As... Ctrl+Shift+S
Upload Ctrl+U
Upload Using Programmer Ctrl+Shift+U
Page Setup Ctrl+Shift+P
Print Ctrl+P
Preferences Ctrl+Comma
Quit Ctrl+Q
1
08.Strings
09.USB
10.StarterKit
ArduinoISP
Audio
Bridge
CAN_BUS
EEPROM
Esplora
Ethernet
Firmata
GSM
LM75_Wire1
Modbus-Master-Slave-for-Arduino
NuEdu_Basic
NuMaker_NuWiCam_M451
OneWire
Robot Control
Robot Motor
Scheduler

Step 3: Select configuration for Nuduino board.

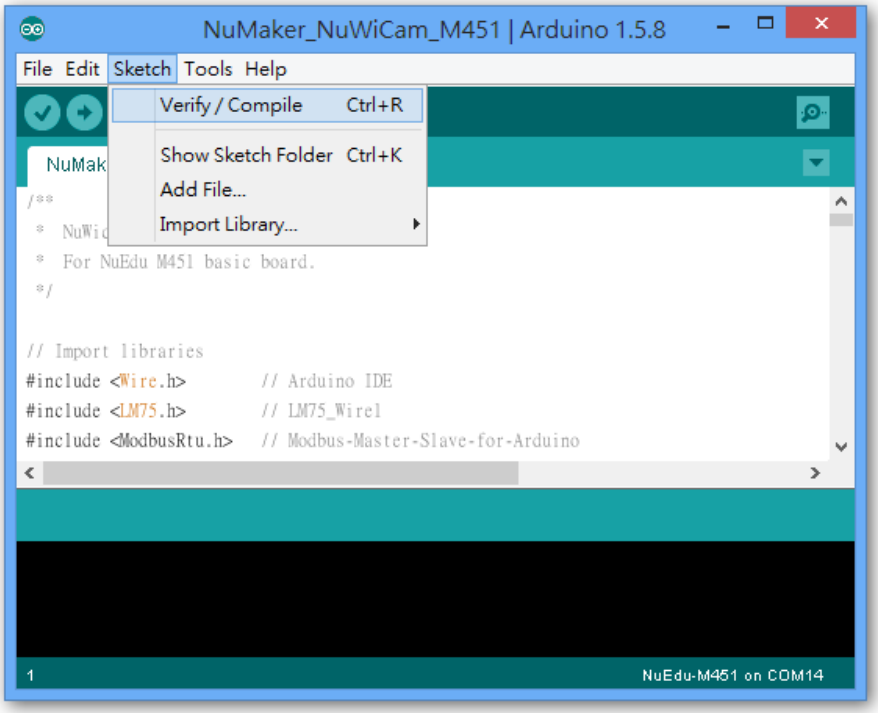
<Tools> → <Board: "NuEdu/M451"> → Select NuEdu-M451.



Step 4: Build sample code.

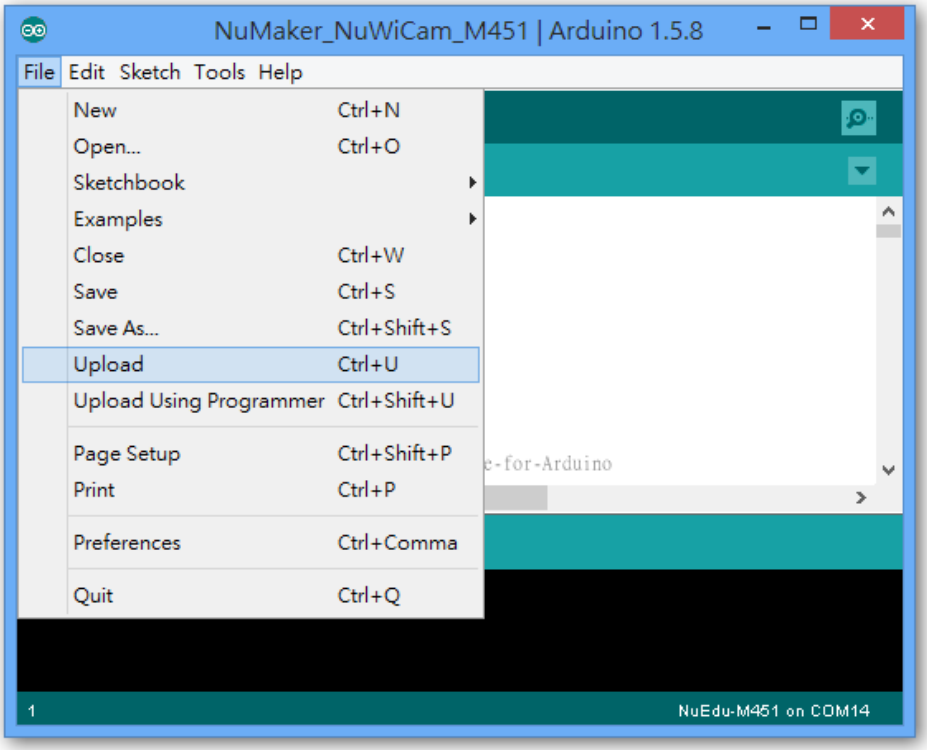
<Sketch> → <Verify/Compile>

Notice: The NuWicam patch for Nuduino 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 NUBED NU472 BOARD

4.1 Board schematics

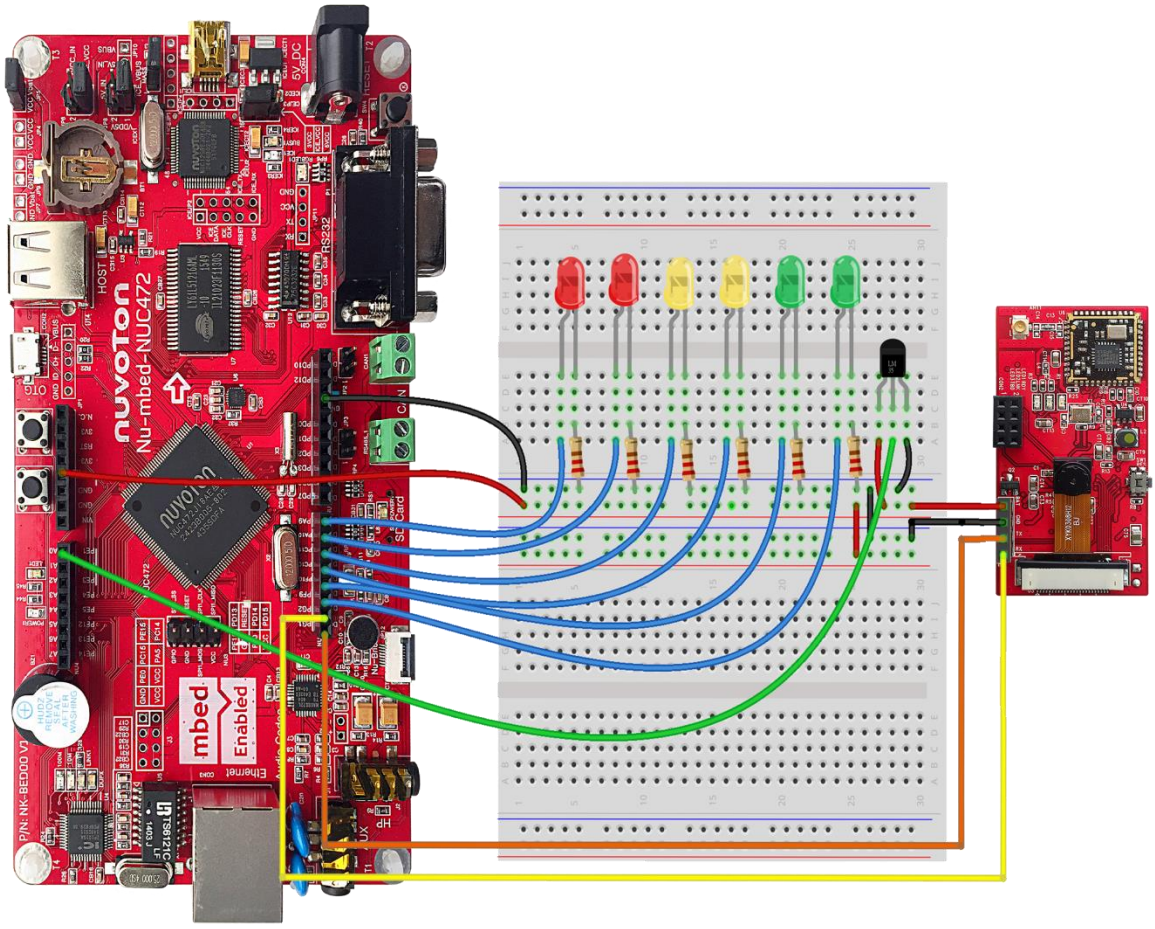


Figure 4-1 NuWicam-VGA board with Nubed NUC472

4.2 Requirement

4.2.1 Hardware

- NuWicam board with firmware x 1
- Nubed 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 Nubed NUC472 board.
  - Please visit ARM website.
  - Path: https://developer.mbed.org/users/wclin/code/NuMaker_NuWicam_Lite/

4.3 Purchasing information

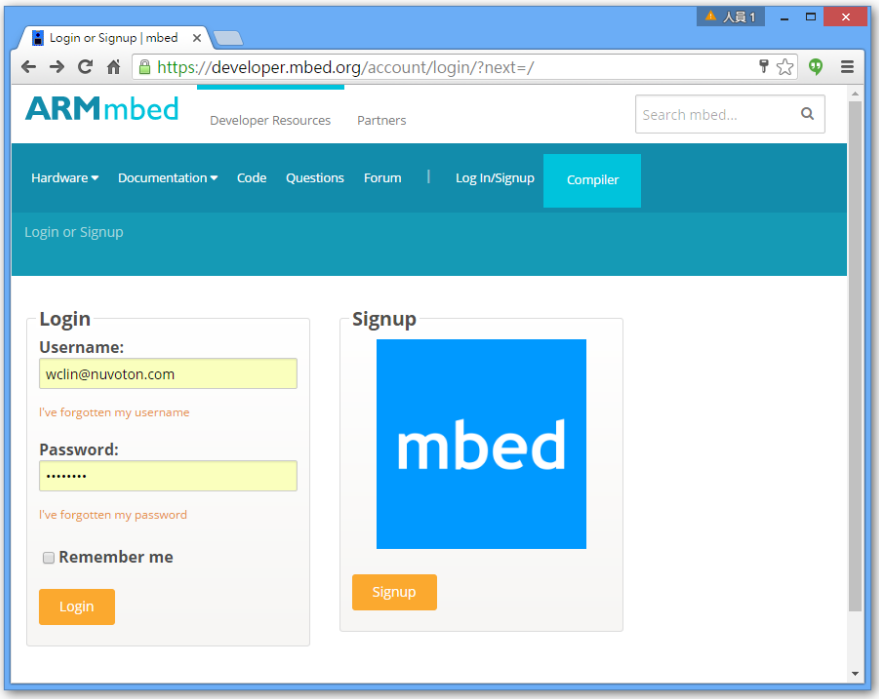
- **Nubed NUC472 board**
  URL: N/A
- **LM35 analog temperature sensor module**
  URL: https://world.taobao.com

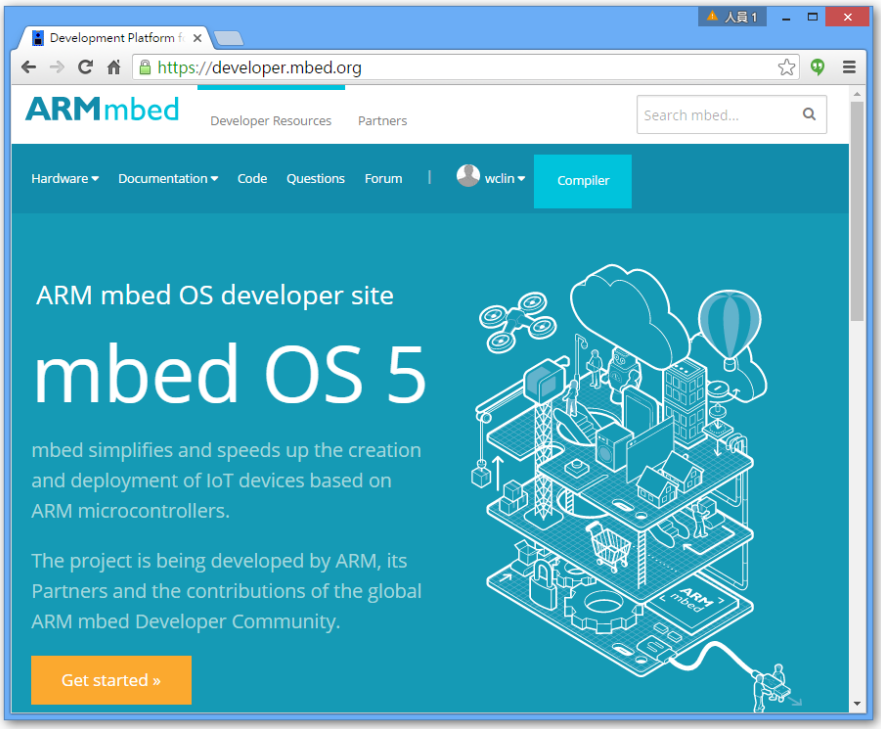
4.4 Sample code building

Please follow below steps to build executable binary.

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

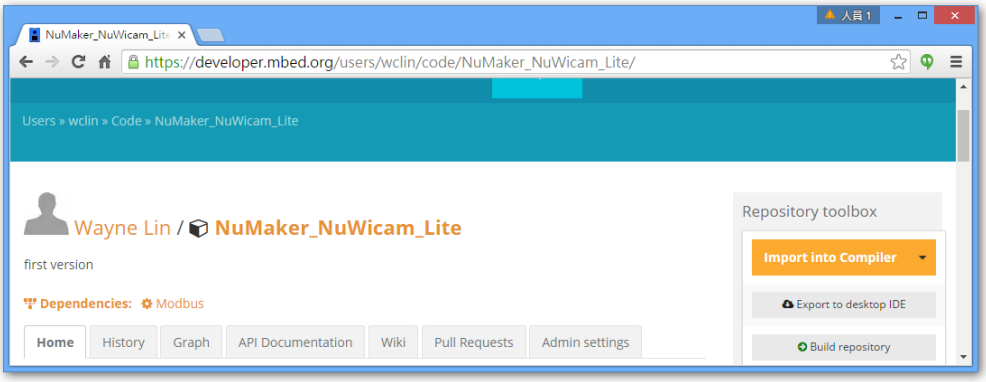
Path: https://developer.mbed.org/

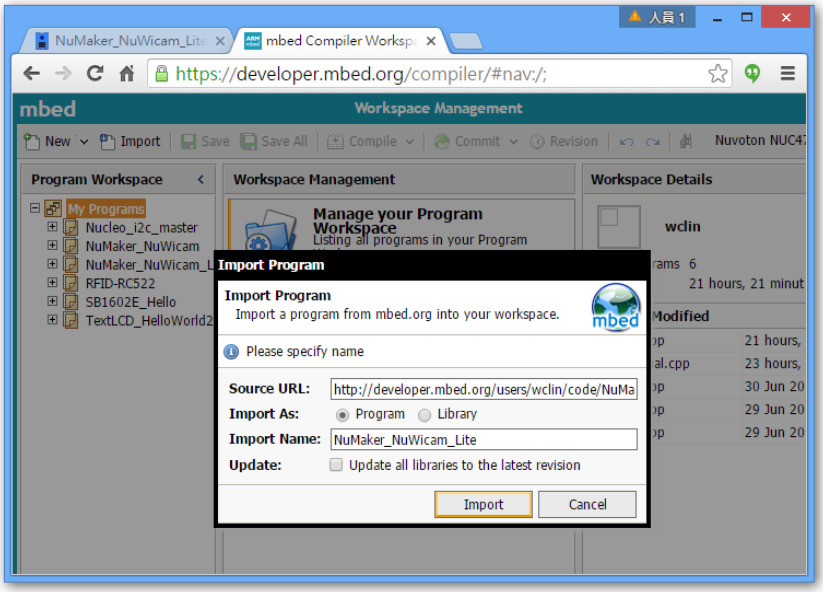


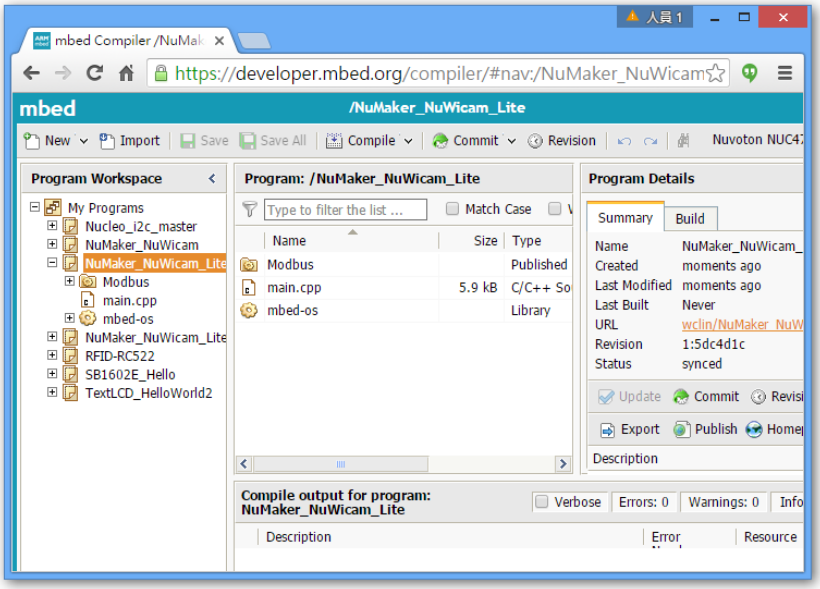


Step 2: Import NuWicam sample into 'ARM mbed Compiler'.

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

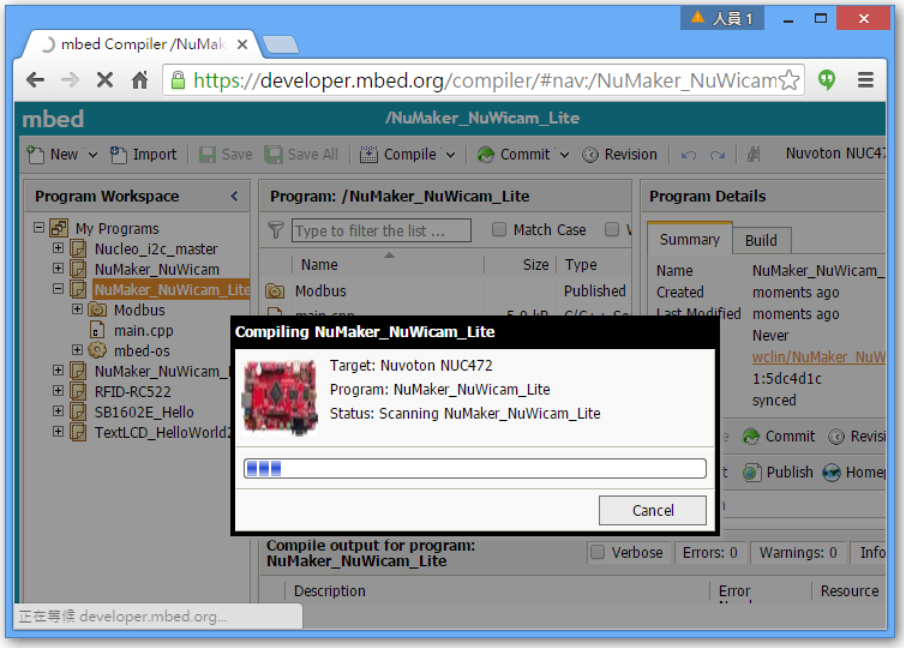


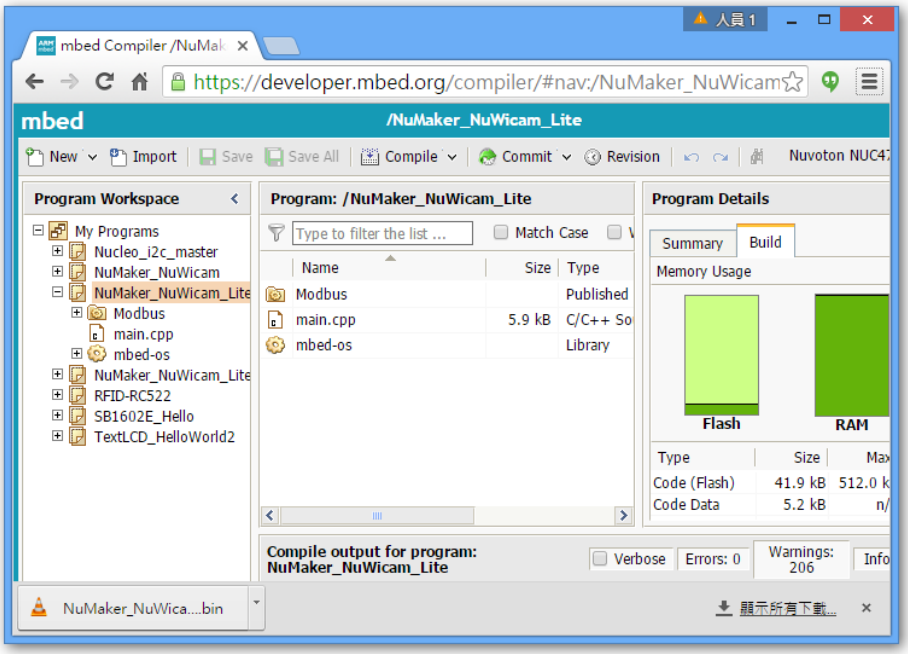




Step 3: Build sample code

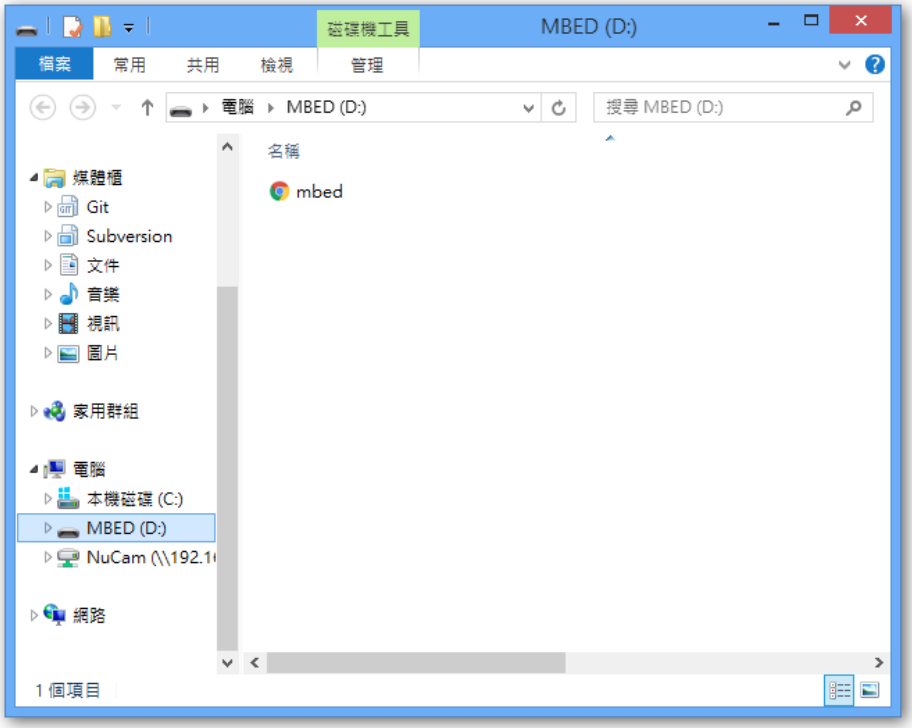
Press **<Compile>** to build the sample code. After done, it will produce downloadable file.

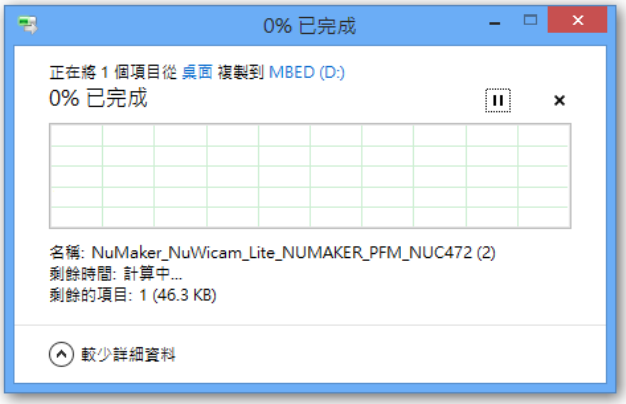

mbed Compiler /NuMak
https://developer.mbed.org/compiler/#nav:/NuMaker_NuWicam
mbed
/NuMaker_NuWicam_Lite
New
Import
Save
Save All
Compile
Commit
Revision
Program Workspace
My Programs
Nucleo_i2c_master
NuMaker_NuWicam
NuMaker_NuWicam_Lite
Modbus
main.cpp
mbed-os
RFID-RC522
SB1602E_Hello
TextLCD_HelloWorld2
Program: /NuMaker_NuWicam_Lite
Type to filter the list ...
Match Case
Name
Size
Type
Modbus
Published
Program Details
Summary
Build
Compiling NuMaker_NuWicam_Lite
Target: Nuvoton NUC472
Program: NuMaker_NuWicam_Lite
Status: Scanning NuMaker_NuWicam_Lite
Cancel
Compile output for program:
NuMaker_NuWicam_Lite
Verbose
Errors: 0
Warnings: 0
Description
Resource


mbed Compiler /NuMak
https://developer.mbed.org/compiler/#nav:/NuMaker_NuWicam
mbed
/NuMaker_NuWicam_Lite
New
Import
Save
Save All
Compile
Commit
Revision
Program Workspace
My Programs
Nucleo_i2c_master
NuMaker_NuWicam
NuMaker_NuWicam_Lite
Modbus
main.cpp
mbed-os
NuMaker_NuWicam_Lite
RFID-RC522
SB1602E_Hello
TextLCD_HelloWorld2
Program: /NuMaker_NuWicam_Lite
Type to filter the list ...
Match Case
Name
Size
Type
Modbus
Published
main.cpp
5.9 kB
C/C++ So
mbed-os
Library
Program Details
Summary
Build
Memory Usage
Flash
RAM
Type
Size
Code (Flash)
41.9 kB
Code Data
5.2 kB
Compile output for program:
NuMaker_NuWicam_Lite
Verbose
Errors: 0
Warnings: 206
NuMaker_NuWica....bin

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.

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.