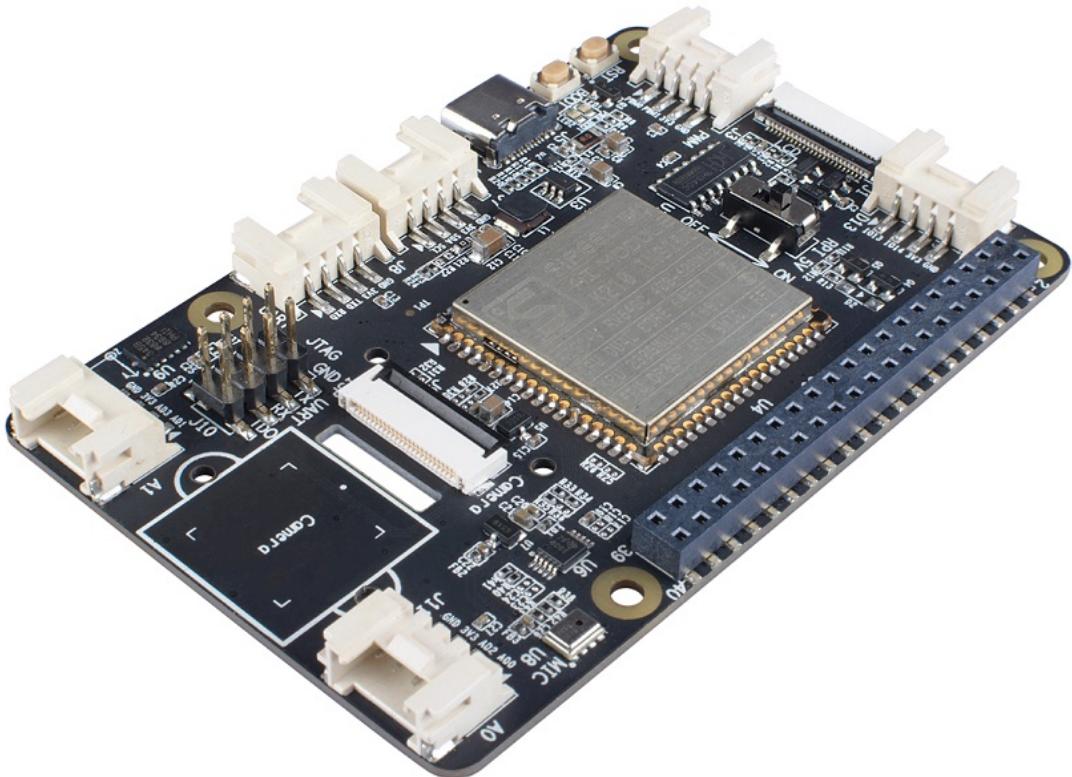


Grove AI HAT for Edge Computing SKU 102991187



The Grove AI HAT for Edge Computing(hereafter called 'Grove AI HAT') is built around Sipeed MAix M1 AI MODULE with Kendryte K210 processor inside. It's a low cost but powerful raspberry pi AI hat which assists raspberry pi run the AI at the edge, it also can work independently for edge computing applications.

The MAix M1 is a powerful RISC-V 600MHz AI module features dual core 64-bit cpu, 230GMULps 16-bit KPU(Neural Network Processor), FPU(Float Point Unit) supports DP&SP, and APU(Audio Processor) supports 8 mics.

In addition to the powerful Kendryte K210 processor, the Grove AI HAT for Edge Computing board provide a wealth of peripherals: I2C/UART/SPI/I2S/PWM/GPIO. The hat also offers LCD and camera interface, which support the Sipeed 2.4inch QVGA LCD and DVP camera, it will be helpful and convenience with your AI vision project. Just like the Sipeed MAix BiT Kit for RISC-V AI+IoT, we will release the kit with camera and LCD soon. For AI voice recognition applications, we add a high-quality microphone. And for robot or motion applications, there is a onboard 3-axis accelerometers sensor, which is more accurate and easy to use compared to external sensors.

We have released varies of SIPPED AI products, we believe it is time to make it Grove, and bring all our hundreds of grove senors and grove acvotors to your AI applications. So here comes the Grove AI HAT for Edge Computing. We've added 6 grove connectors to this hat, including 1xDigital IO, 2xAnalog IO, 1xI2C, 1xUART and 1xPWM. On top of that, based on [kendryte-standalone-sdk](#), we added the full [ArduinoCore-API](#)

interface to support Arduino IDE, Linux, Windows, Mac OS X and other development environments. Which means you can run Grove Arduino Libraries and many [excellent Arduino libraries](#) on this board easily.

We hope this board may help you with your edge computing, AI vision, voice recognition, and other AI projects, just enjoy it.

<https://www.youtube.com/embed/5BF3ExL1HOQ>

Features

- Processor: Sipeed MAIX-I module w/o WiFi (1st RISC-V 64 AI Module, K210 inside)
- 1x USB 2.0 Device, Type C(Power and Programming)
- 6x Grove Interface: include 1x Digital IO, 1x PWM, 1x I2C, 1x UART, 2x ADC
- 1x Power LED, 1x Boot LED
- 1x Reset Button, 1x Boot Button
- 1x LCD Interface
- 1x Camera Interface
- 1x Digital Mic
- 1x Accelerometers Sensor
- 1x JTAG & ISP UART Pin Header
- 2x 20 Pin Header with I2C, UART, SPI, I2S, PWM, GPIO

Specification

Parameter	Value
CPU	K210 RISC-V Dual Core 64bit, 400Mhz(Max. 600Mhz)
FPU	IEEE754-2008 compliant high-performance pipelined FPU
KPU(Neural Network Processor)	<ul style="list-style-type: none">• Supports the fixed-point model that the mainstream training framework trains according to specific restriction rules• Support for 1x1 and 3x3 convolution kernels• Support for any form of activation function• The maximum supported neural network parameter size for real-time work is 5MiB to 5.9MiB
APU(Audio Processor)	<ul style="list-style-type: none">• Up to 192kHz sample rate• Up to 8 channels of audio input data, ie 4 stereo channels
Debugging Support	High-speed UART and JTAG interface for debugging
Supply Voltage	5V can not exceed 5.5V
IO Voltage	3.3V
Operating Ambient Temperature	-20 – 70°C
ADC	Onboard 16-bit ADC

Parameter	Value
3-Axis Accelerometers	ADXL345 ±2 g/±4 g/±8 g/±16 g
Microphone	Sensitivity:-26 dB;SNR:61 dB
GPIO	2x 20 Pin Header compatible with Raspberry Pi
Grove Interface	1x Digital IO, 1x PWM, 1x I2C, 1x UART, 2x ADC
USB Interface	USB 2.0 Device, Type C(Power and Programming)
LCD Interface	8bit MCU LCD 24P 0.5mm FPC connector
DVP Camera Interface	24P 0.5mm FPC connector
Button	1x Reset Button, 1x Boot Button (can be used as User Button)
LED	1x Power LED, 1x Boot LED(can be used as User LED)

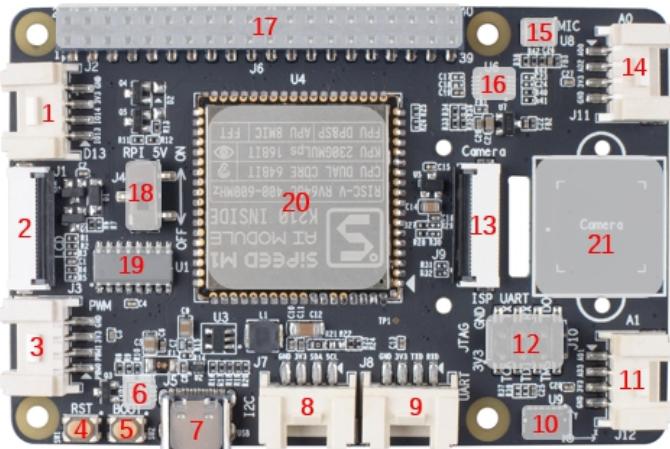
!!!Attention - All digital and analog IO interface levels are 3.3V. Please do not input more than 3.3V, otherwise the CPU may be damaged.

- The input power supply voltage is 5V and cannot exceed 5.5V.

Applications

- AI for Edge Computing
- Smart Building
- Medical equipment
- Automation & Process Control
- Robot

Hardware Overview



- | | |
|-------------------------------------|--|
| 1: J2 , Grove , Digital IO | 12: J10 , 2x4 Pin Header , JTAG & ISP UART |
| 2: J1 , LCD Interface | 13: J9 , Camera Interface |
| 3: J3 , Grove , PWM | 14: J11 , Grove , ADC A0 |
| 4: SW1 , Reset Button | 15: U8 , MIC |
| 5: SW2 , Boot Button | 16: U6 , I2C to ADC IC |
| 6: LED1 , 3.3V LED; LED2 , Boot LED | 17: J6 , 2x20 Pin Socket |
| 7: J5 , USB Type C | 18: J4 , Toggle Switch for RPI 5V |
| 8: J7 , Grove , I2C | 19: U1 , USB to UART IC |
| 9: J8 , Grove , UART | 20: U4 , Sipeed AI Module |
| 10: U9 , Accelerometers Sensor | 21: Camera mounting slot |
| 11: J12 , Grove , ADC A1 | |

Figure 1. Grove AI HAT for Edge Computing hardware overview

Platforms Supported

Arduino	Raspberry Pi	BeagleBone	Wio	LinkIt ONE

Getting Started

!!!ReadMe - When the board is used in standalone mode, please turn the toggle switch J4 to the ON terminal. Then the Pin2 and Pin4 of the 2x20Pin socket J6 will connect to 5V power.

- When the board is plugged into the Raspberry Pi, if only one board is powered, J4 needs to be dialed to the ON end; if the board and the Raspberry Pi use different USB power at the same time, J4 needs to be dialed to the OFF end to disconnect. The two sets of 5V connections on the J6 avoid the two USB power supplies being directly connected.

Play With Arduino

!!!Attention If this is the first time you work with Arduino, we strongly recommend you to see [Getting Started with Arduino](#) before the start.

In theory, Grove AI HAT can be compatible with all Grove modules, but inevitably there will be compatibility issues. If you find a Grove module that is not compatible with the Grove AI HAT, please submit it to our [Github Page](#).

Arduino config

- **Step 1.** Configure the Arduino Board Manager URL.

Click **File --> Preference**, copy the following URL into the **Additional Boards Manager URLs**

```
https://raw.githubusercontent.com/Seeed-Studio/Seeed_Platform/master/package_seeeduino_boards_index.json
```

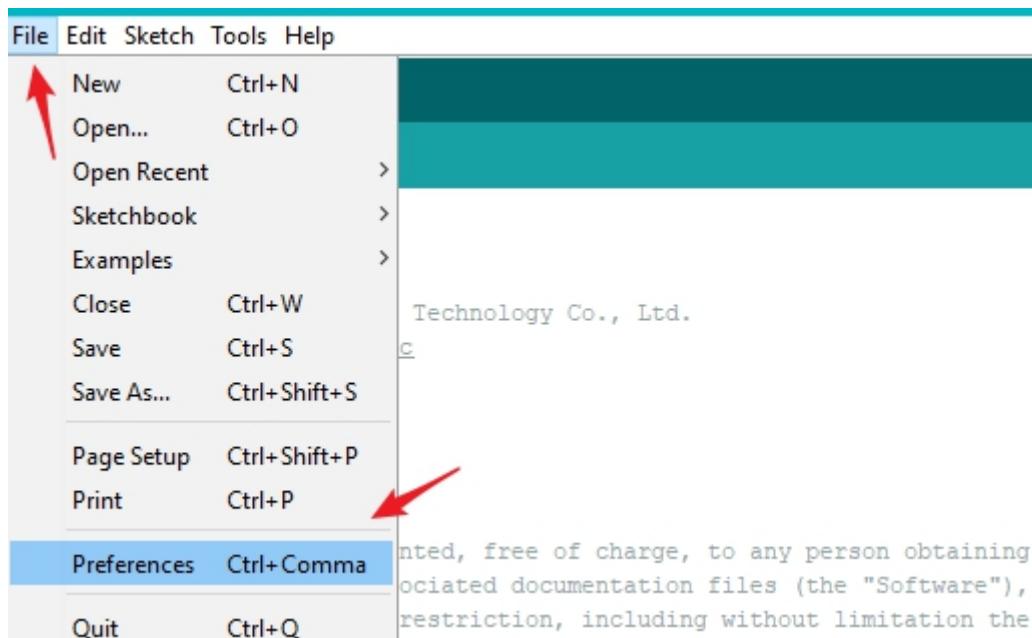


Figure 2. Arduino Board URL config

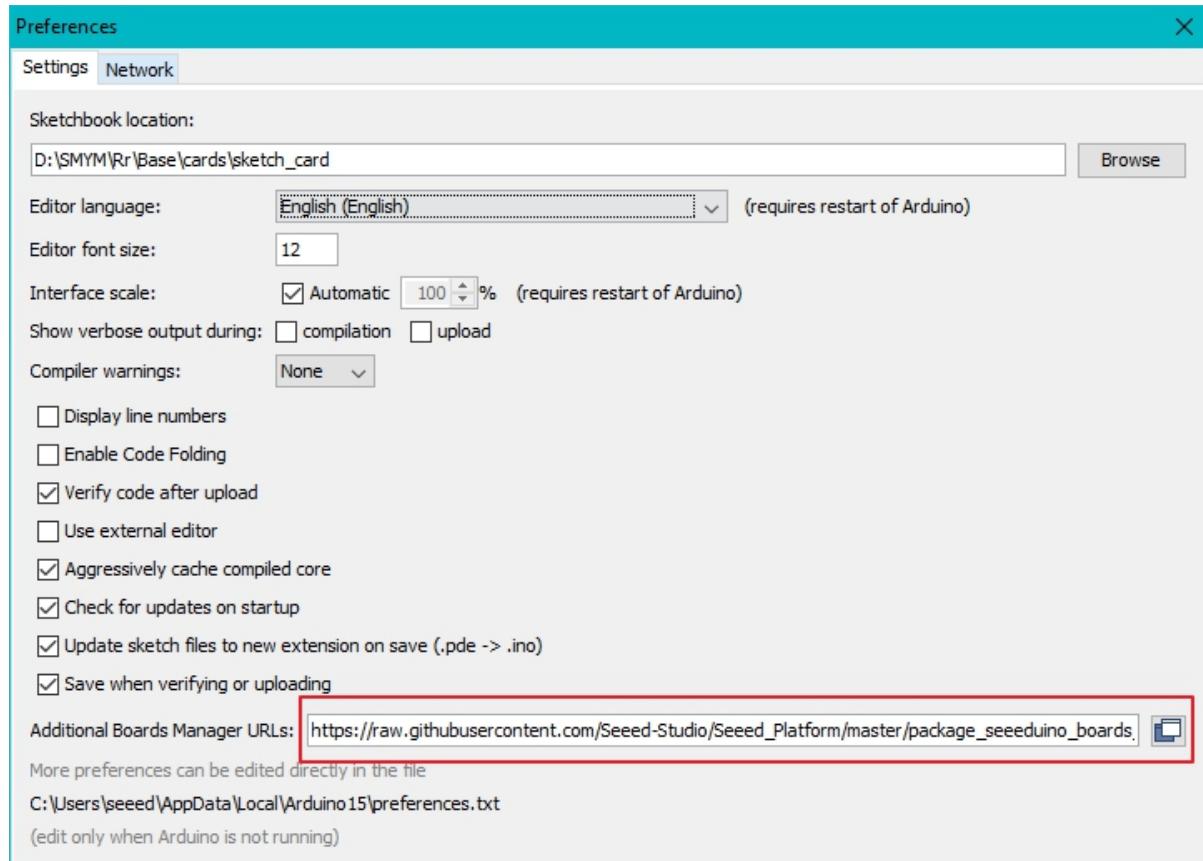


Figure 3. Arduino Board URL config

- **Step 2.** Add the Grove AI HAT board into Arduino IDE.

Click **Tools** --> **Board: "xxxx"** -->**Boards Manager**, tap **K210** into the search bar.

Find the **Grove AI HAT for Edge Computing by Seeed Studio**, click Install button.

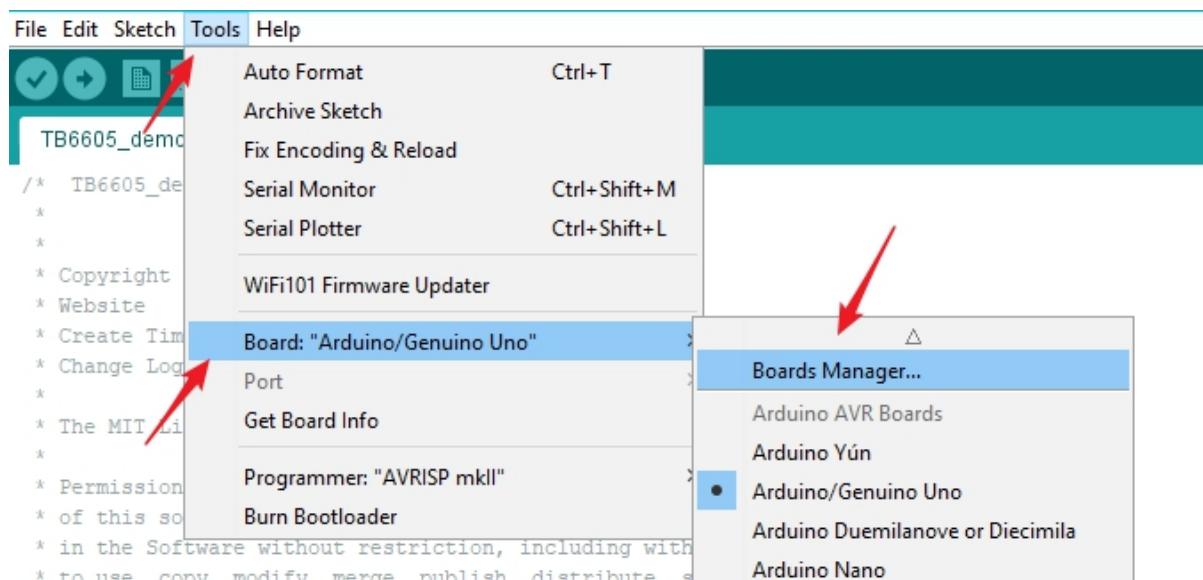


Figure 4. Open Board Manager

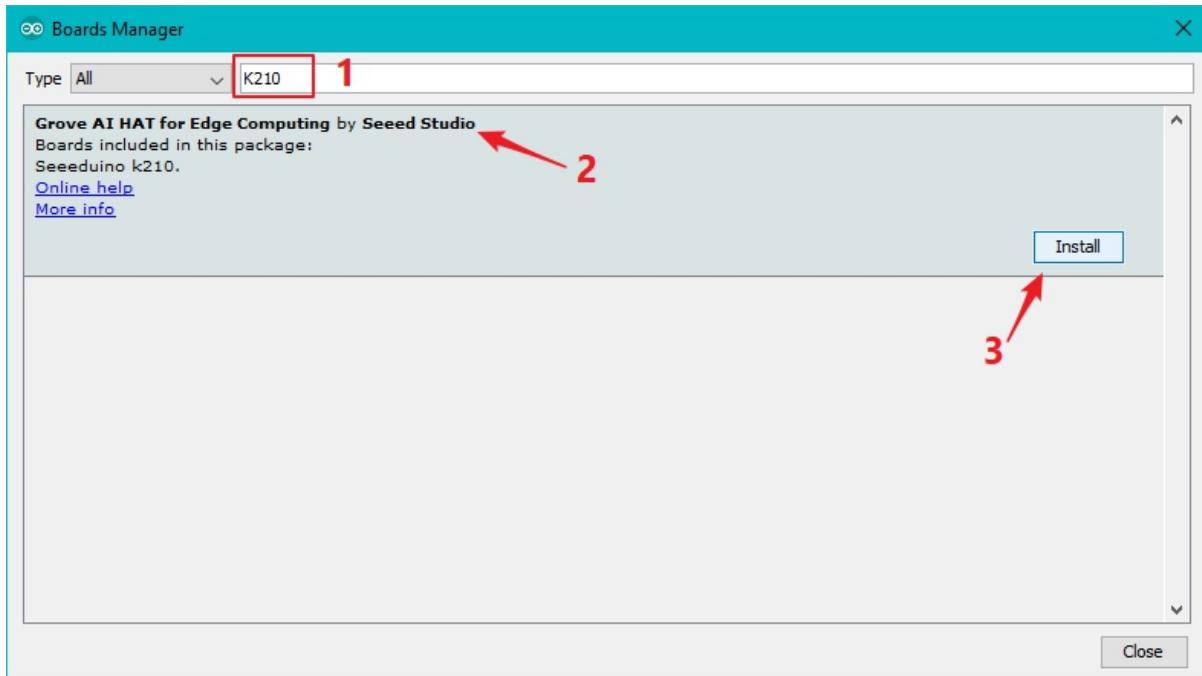


Figure 5. Install the Grove AI HAT Board

When the installation is complete, you can find the **Seeed K210 Pi** board in the Arduino board list.

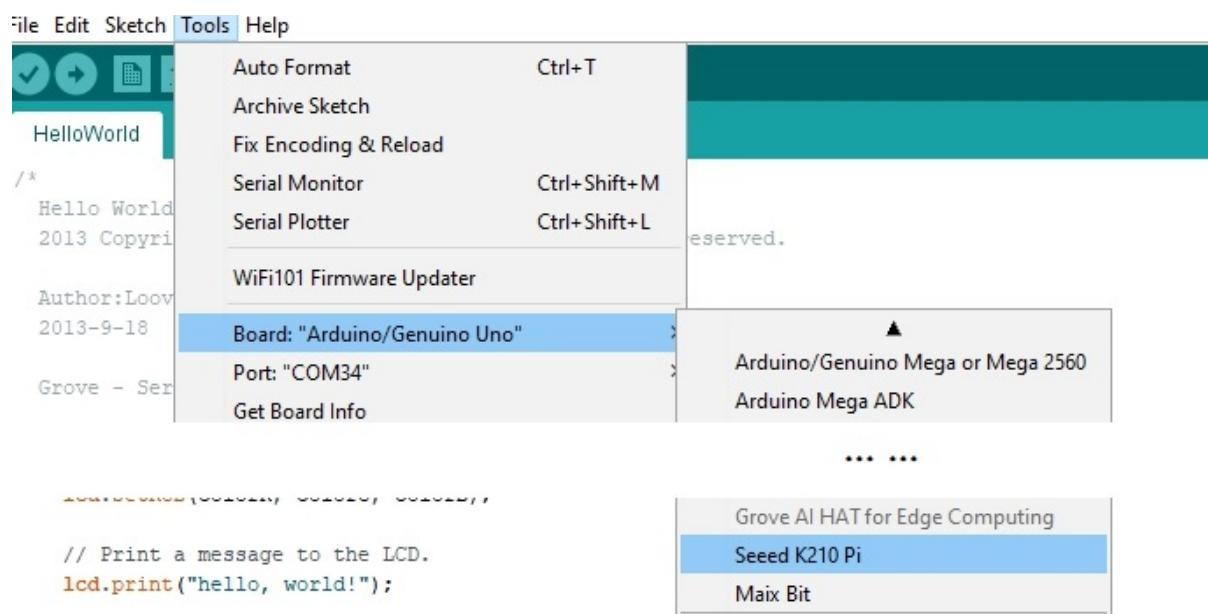


Figure 6. Select Seeed K210 Pi

Also, to use the Grove AI HAT in the Arduino IDE, you need to select the **K-flash** Programmer at the Arduino Programmer list.

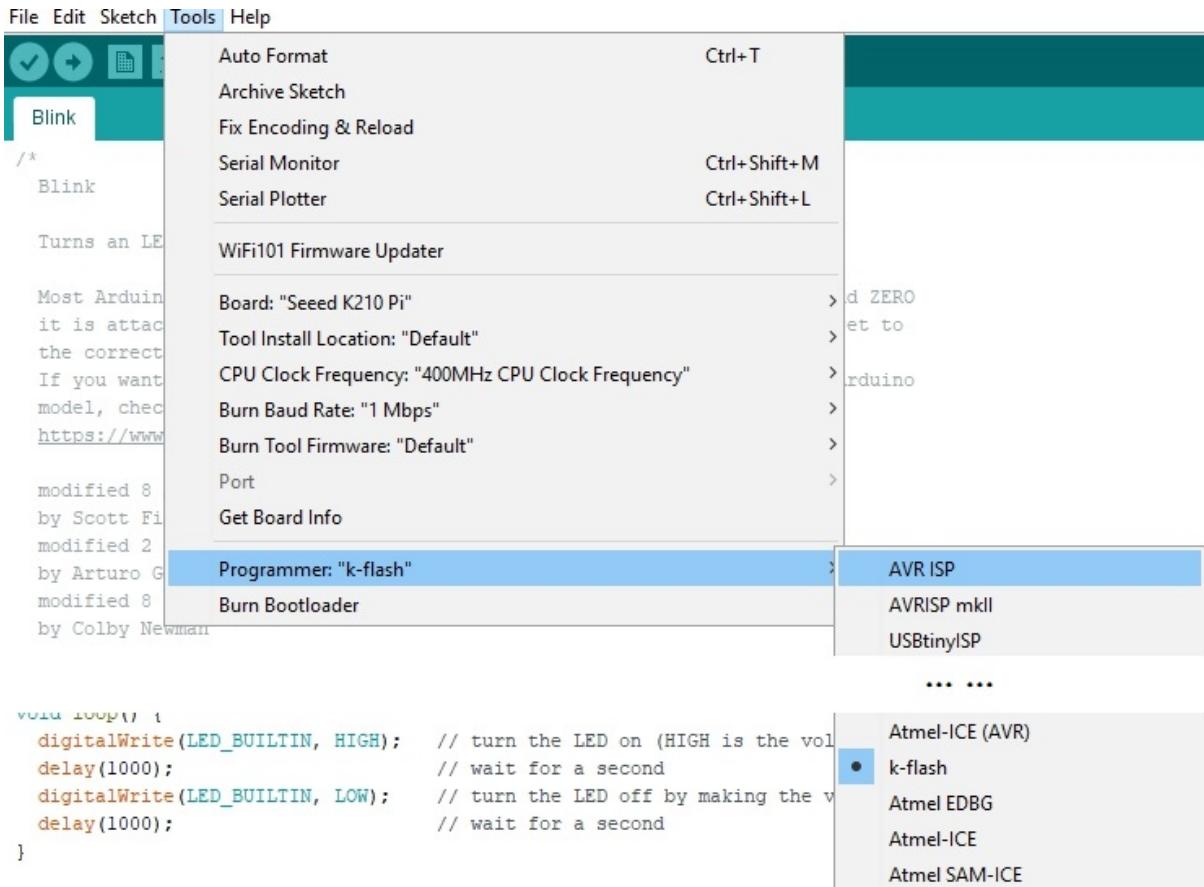


Figure 7. Select K-flash Programmer

Digital Demo

Materials required

- Grove AI HAT for Edge Computing x1
- Grove - LED x1
- USB Type C cable x1

Hardware Connection

- 1 Connect the Grove - LED to the Grove **J2** port(D13 pin) of the Grove AI HAT
- 2 Connect the Grove AI HAT to the computer via USB Type C port.

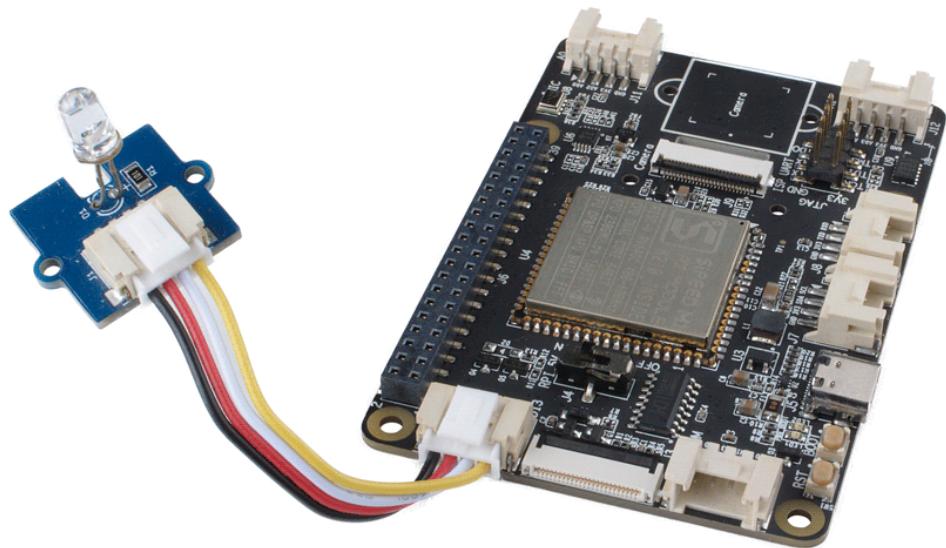


Figure 8. Hardware connection

Software

- **Step 1.** Create a new blank sketch in your Arduino IDE, copy the following code into that sketch.

```
void setup() {  
    // initialize digital pin LED_BUILTIN as an output.  
    pinMode(13, OUTPUT);  
}  
  
void loop() {  
    digitalWrite(13, HIGH);      //  
    delay(1000);                // wait for a second  
    digitalWrite(13, LOW);       //  
    delay(1000);                // wait for a second  
}
```

- **Step 2.** Upload the demo. If you do not know how to upload the code, please check [How to upload code](#).

After done uploading, the Grove - LED will flash.

Analog Demo

Materials required

- Grove AI HAT for Edge Computing x1
- Grove - Round Force Sensor (FSR402) x1
- USB Type C cable x1

Hardware Connection

- 1 Conect the Grove - Round Force Sensor (FSR402) to the Grove **J11** port(A0 pin) of the Grove AI HAT
- 2 Conect the Grove AI HAT to the computer via USB Type C port.

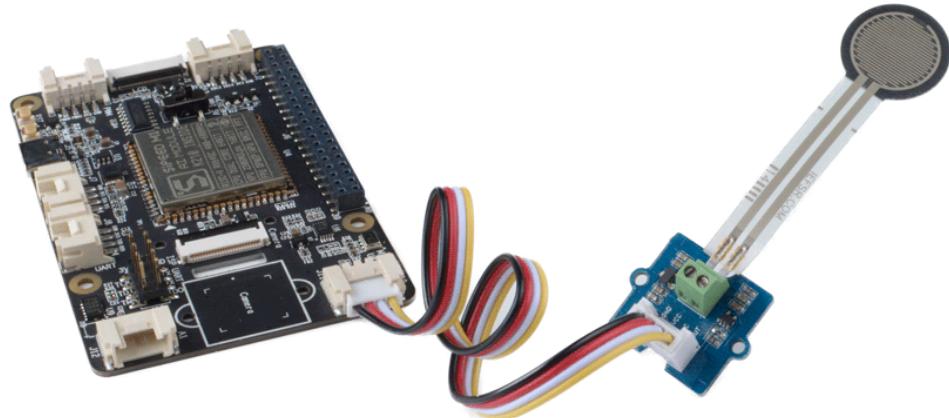


Figure 9. Hardware connection

Software

- **Step 1.** Download the [ADS1115 library](#)
- **Step 2.** Open the demo at **File --> Examples -->ADS-1115-master -->Example -->ADS1115_ReadVoltage**

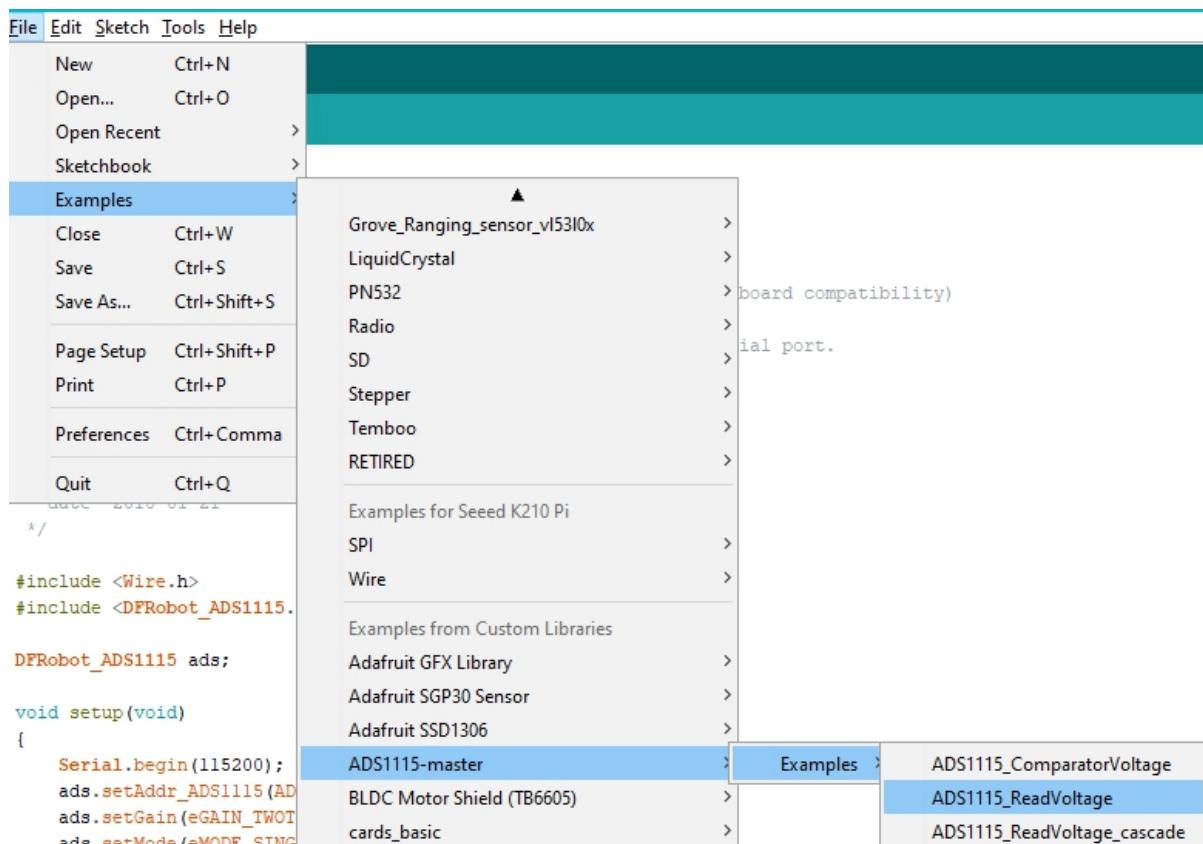


Figure 10. ADC Demo Path

- **Step 3.** Upload the demo. If you do not know how to upload the code, please check [How to upload code](#).
- **Step 4.** Open the **Serial Monitor** of Arduino IDE by click **Tool-> Serial Monitor**. Or tap the **++ctrl+shift+m++** key at the same time. Set the baud rate to **115200**.

Then, press the Grove - Round Force Sensor, the A0 valnue will change.

```
A0:1586mV, A1:571mV, A2:561mV, A3:567mV
A0:1586mV, A1:570mV, A2:561mV, A3:566mV
A0:1586mV, A1:570mV, A2:559mV, A3:566mV
A0:1676mV, A1:570mV, A2:561mV, A3:565mV
A0:2693mV, A1:570mV, A2:558mV, A3:564mV
A0:2618mV, A1:570mV, A2:555mV, A3:562mV
A0:1586mV, A1:567mV, A2:553mV, A3:562mV
A0:1586mV, A1:567mV, A2:552mV, A3:564mV
A0:1586mV, A1:568mV, A2:551mV, A3:564mV
A0:1586mV, A1:568mV, A2:550mV, A3:566mV
A0:2686mV, A1:570mV, A2:551mV, A3:566mV
A0:2482mV, A1:571mV, A2:552mV, A3:567mV
A0:2202mV, A1:570mV, A2:553mV, A3:566mV
A0:1645mV, A1:569mV, A2:555mV, A3:567mV
A0:1603mV, A1:570mV, A2:557mV, A3:568mV
A0:1587mV, A1:572mV, A2:560mV, A3:568mV
A0:1586mV, A1:571mV, A2:561mV, A3:568mV
```

Figure 11. Output

kendryte k210 Standalone SDK

In order to use the kendryte k210 Standalone SDK with Grove AI HAT you should config the Arduino IDE as the previous chapter [Play with Arduino](#).

Now let's assume that you have downloaded the K210 development board in the Arduino IDE, selected **Seeed K210 Pi** board and **k-flash**.

First of all download the [kendryte-standalone-demo](#) at github.

We will take the [face_detect](#) for instance.

Face Detect Demo

Materials required

- Grove AI HAT for Edge Computing x1
- OV2640 Camera x1
- 2.4 inch TFT LCD x1
- USB Type C cable x1

Hardware Connection

- a. Connect the OV2640 camera into the Grove AI Hat 24 pin FPC camera connector
- b. Connect the 2.4 inch TFT LCD into the Grove AI Hat 24 pin FPC LCD connector
- c. Connect the Grove AI HAT to the computer via USB Type C port.

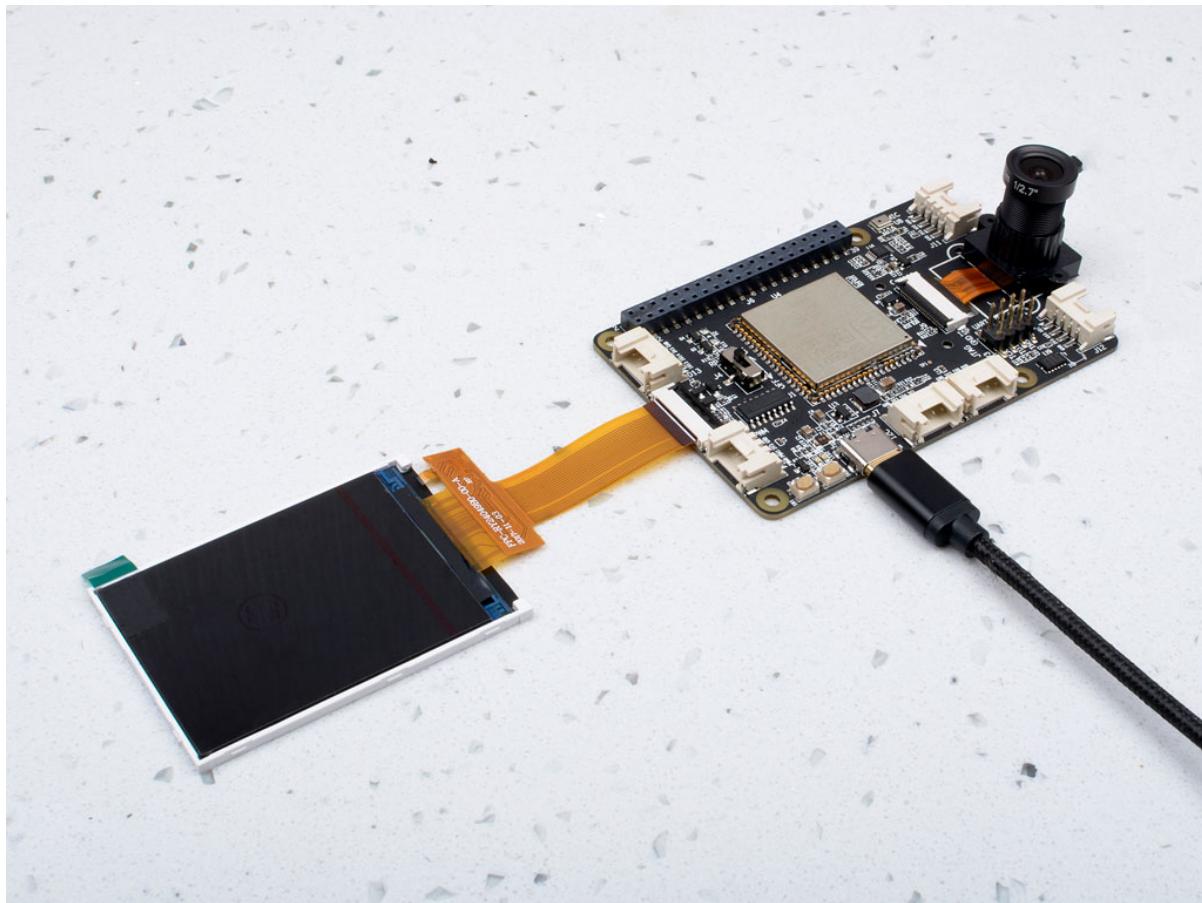


Figure 12. Hardware connection of face detect demo

Software

Download the AI module

- Step 1. Enter the folder, **D:XXXXXX\kendryte-standalone-demo\face_detect\kfpkg**, D:XXXXXX is the path where you download the **kendryte-standalone-demo**. You will find four files as following:

This PC > DataBase (D:) > WorkWork > 2019_Product_Shelves > S2 > AI hat > kendryte-standalone-demo > face_detect > kfpkg			
Name	Date modified	Type	Size
detect.kmodel	5/16/2019 5:49 PM	KMODEL File	380 KB
face_detect.bin	5/16/2019 5:49 PM	BIN File	94 KB
face_detect.kf pkg	5/16/2019 5:49 PM	KFPKG File	382 KB
flash-list.json	5/16/2019 5:49 PM	JSON Source File	1 KB

Figure 13. This folder contains the AI module of face detect

- Step 2. Open the Arduino IDE, click **File --> Preferences**, click on the part marked in the red box to open the Arduino package folder.

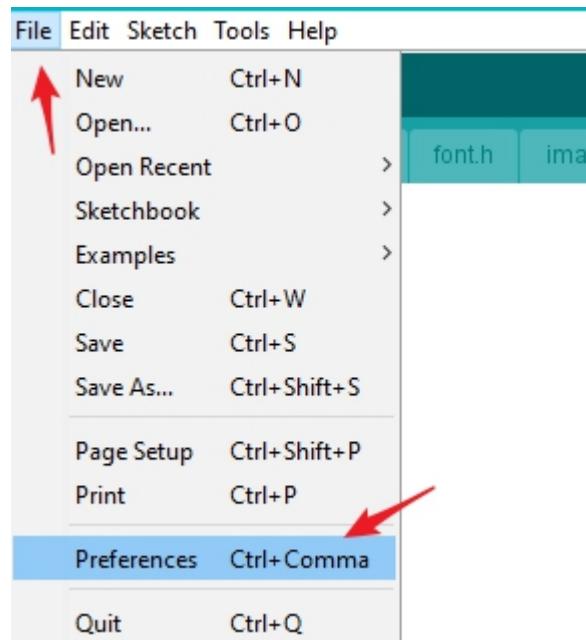


Figure 14. Open preferences windows

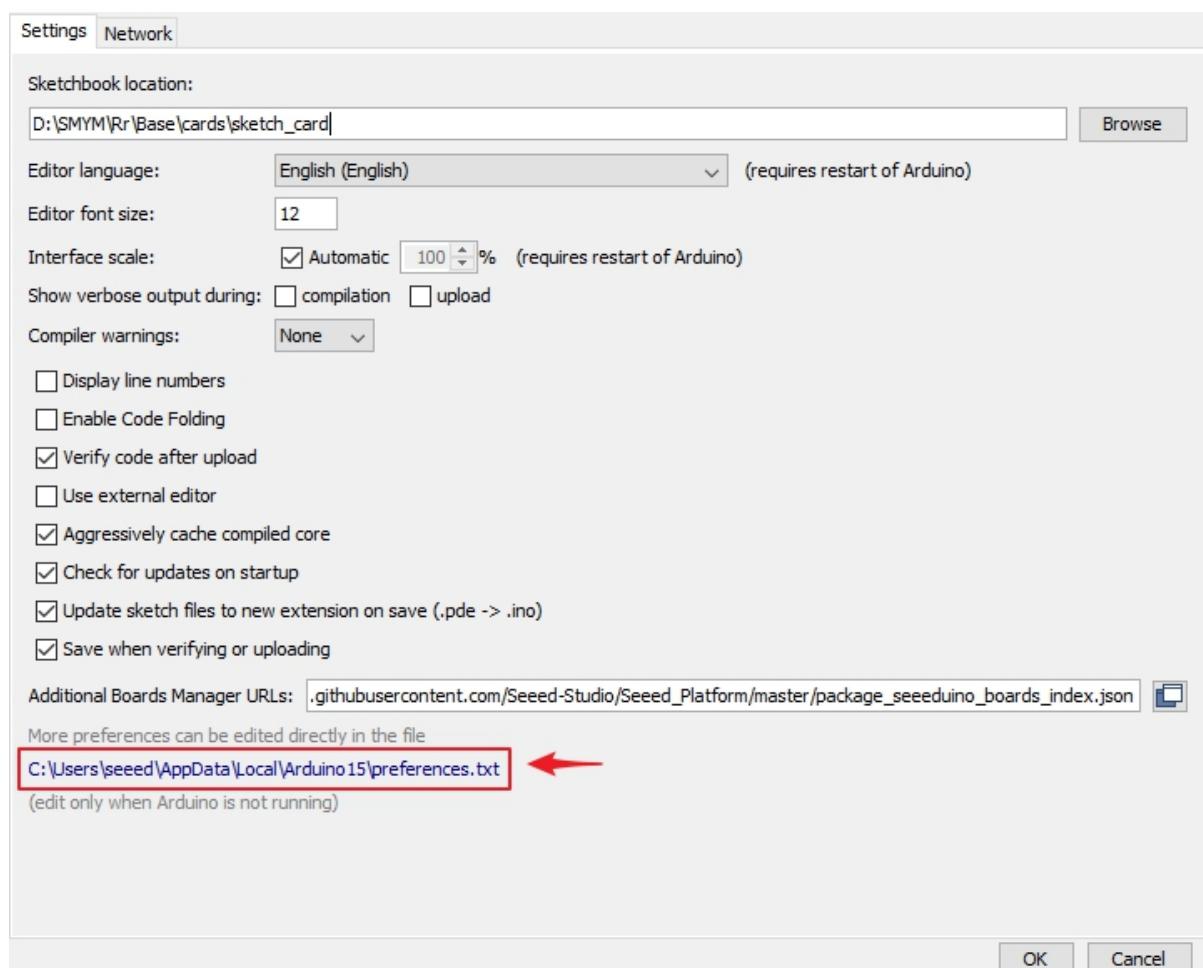
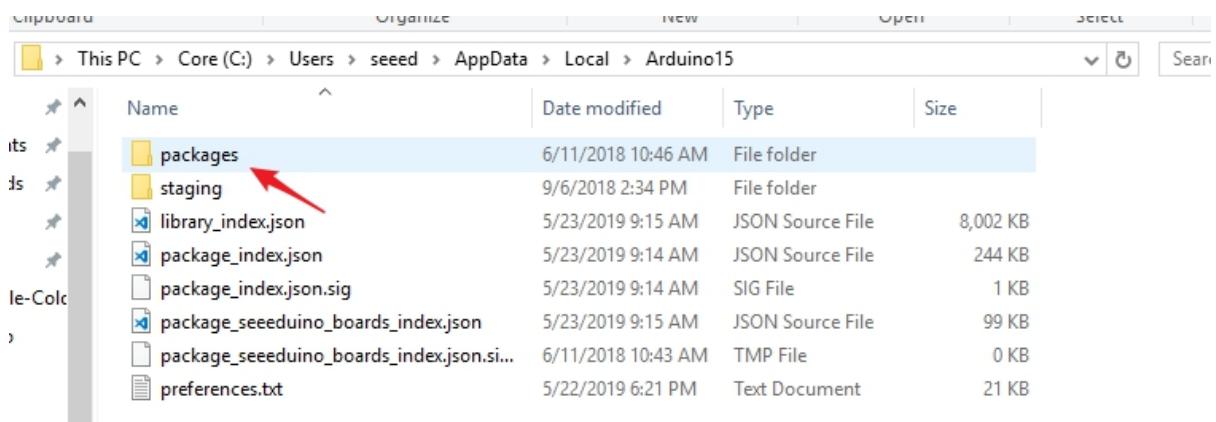


Figure 15. Click on the part marked in the red box



Name	Date modified	Type	Size
packages	6/11/2018 10:46 AM	File folder	
staging	9/6/2018 2:34 PM	File folder	
library_index.json	5/23/2019 9:15 AM	JSON Source File	8,002 KB
package_index.json	5/23/2019 9:14 AM	JSON Source File	244 KB
package_index.json.sig	5/23/2019 9:14 AM	SIG File	1 KB
package_seeeduino_boards_index.json	5/23/2019 9:15 AM	JSON Source File	99 KB
package_seeeduino_boards_index.json.sig	6/11/2018 10:43 AM	TMP File	0 KB
preferences.txt	5/22/2019 6:21 PM	Text Document	21 KB

Figure 16. Click on the part marked in the red box

- Step 3. Find the **Kflash_py.exe** in the path **XXXXX\packages\Seeeduino\tools\kflash\1.1.0**, XXXX is the folder you just open by click the links in the Arduino references Windows. For instance mine is **C:\Users\seeed\AppData\Local\Arduino15\packages\Seeeduino\tools\kflash\1.1.0**, copy the whole path of your own, we need to use it in the next step.

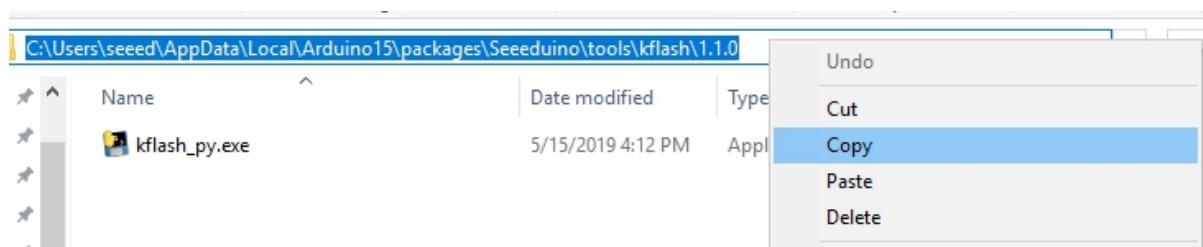


Figure 17. Copy the path of Kflash_py.exe

- Step 4. Back to the **kfpkg** folder, enter a command console, you can use any console you like. If you don't know how to open one, for win10 user, you can click **File -->Open Windows Power Shell -->Open Windows Power Shell**

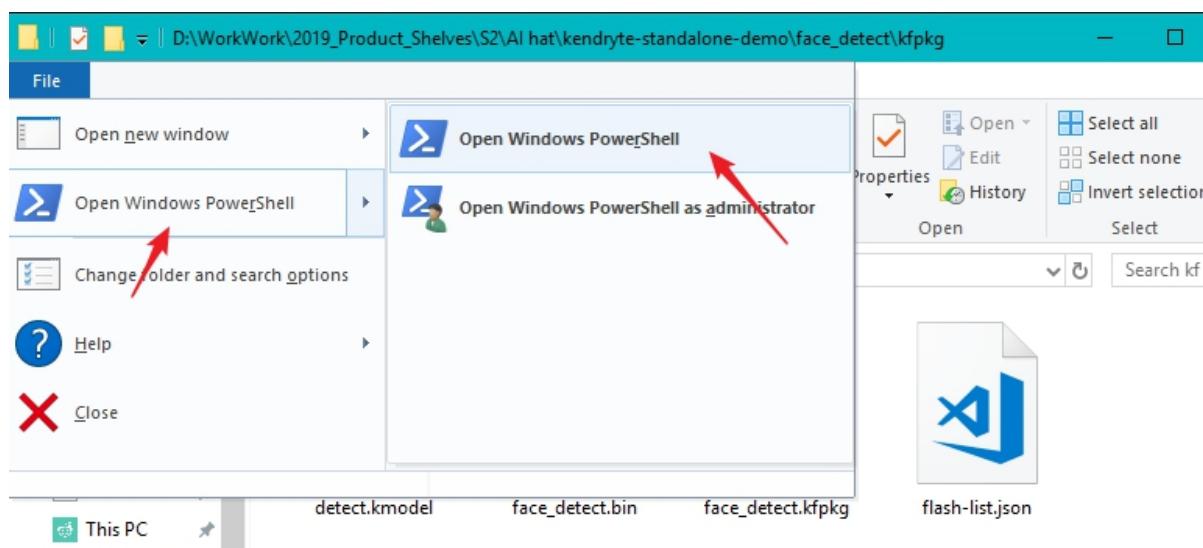


Figure 18. Open power shell

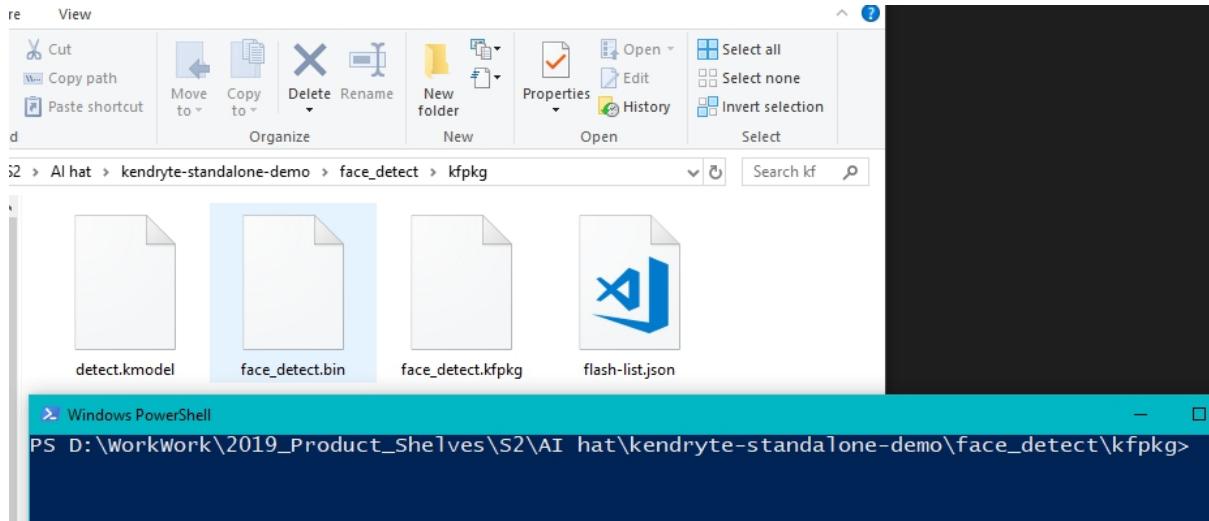


Figure 19. Open power shell

- Step 5. Download the AI module into your Grove AI Hat
Remember the path we copied in the **step3?** Mine is:

```
C:\Users\seeed\AppData\Local\Arduino15\packages\Seeeduino\tools\kflash\1.1.0
```

For windows user, you should change all the \ in the path into /, then we get:

```
C:/Users/seeed/AppData/Local/Arduino15/packages/Seeeduino/tools/kflash/1.1.0
```

Replace the following command with you own Path

```
C:/Users/seeed/AppData/Local/Arduino15/packages/Seeeduino/tools/kflash/1.1.0/kflash_py -n -p COM31 -b 2000000 -B dan face_detect.kf pkg
```

Check your COM number in the Computer Device Manager

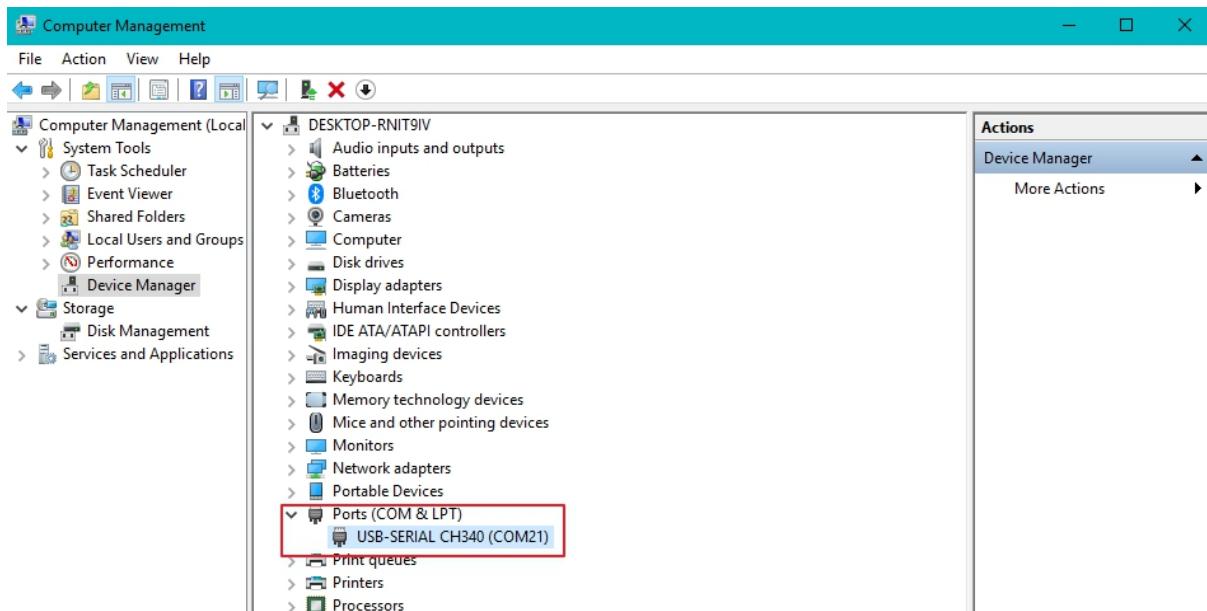


Figure 20. Check the COM number

Replace the COM number with your own COM number, as you can see, mine is COM21, then enter the following command and run:

```
C:/Users/seeed/AppData/Local/Arduino15/packages/Seeeduino/tools/kflash/1.1.0/kflash_py -n -p COM21 -b 2000000 -B dan face_detect.kfpkg
```

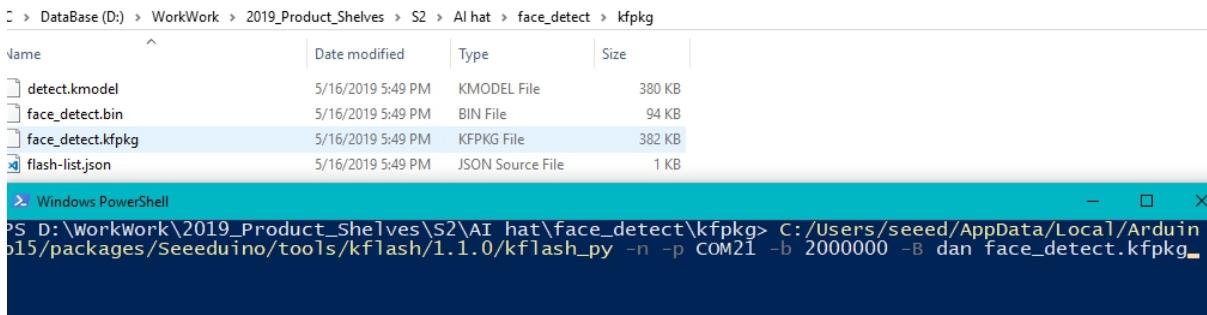


Figure 21. Replace the Path of kflash_py and the COM port number with your own path and COM port

When the download is finish, you will see:

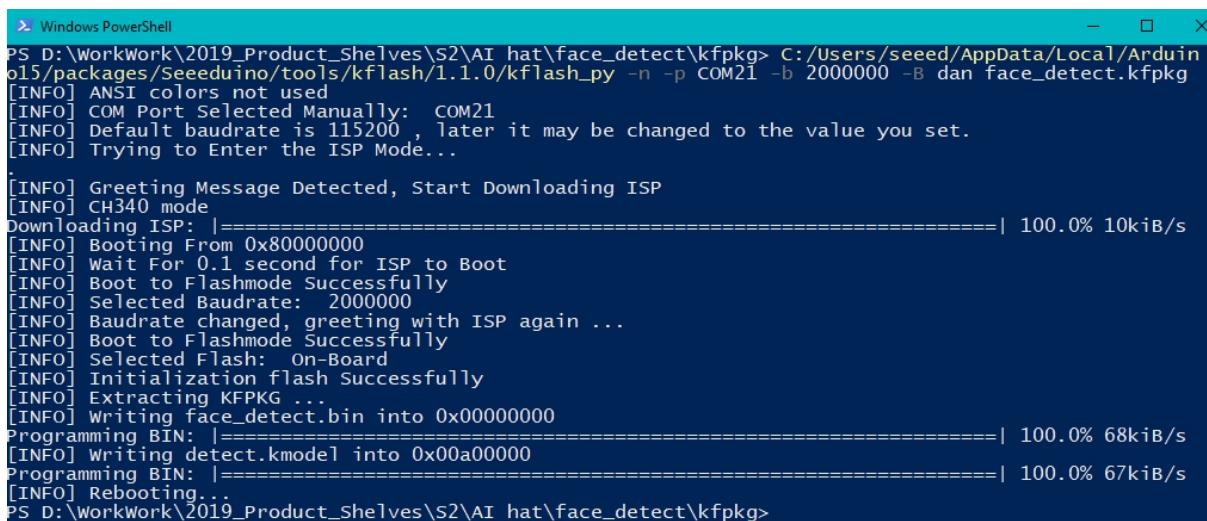


Figure 22. Download Success

Now you will see the LCD screen light on with full white. Let's move to next step.

Download Demo code

- Step 1. Create a new folder, create a new blank `xxx.ino` file. `xxx` must be the same as the folder name.
For instance both of mine is `Face_Detect_Demo`

!!!Attention Please make sure the `.ino` file is blank and the `.ino` name is the same as your folder.

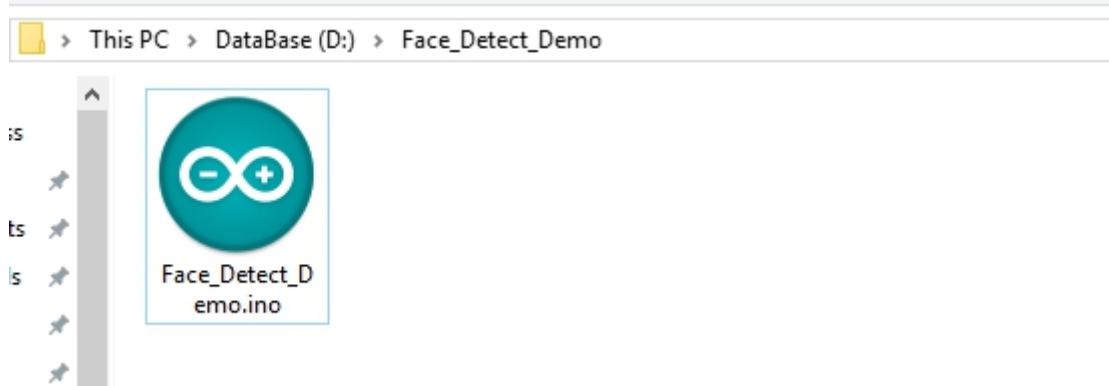


Figure 23. Great blank `ino`

- Step 2. Copy all the files in the folder `XXXXX\kendryte-standalone-demo\face_detect` into the new folder you've just created.

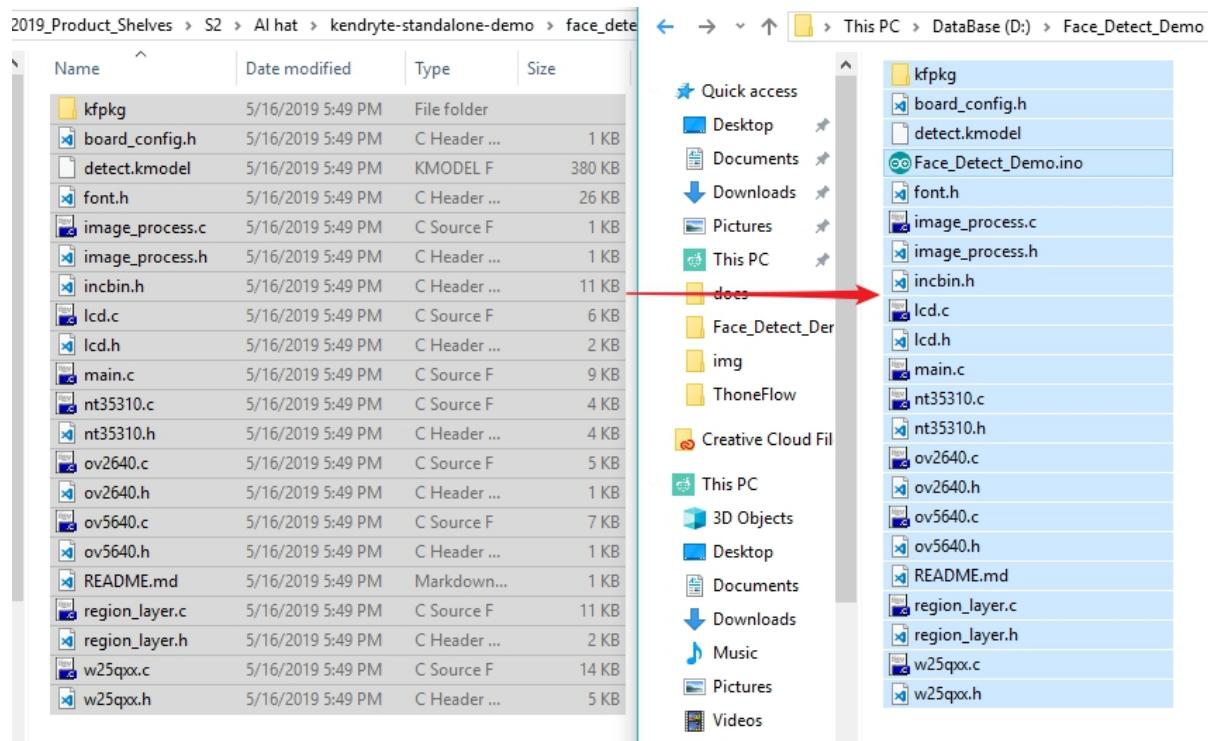


Figure 24. Copy file into the `ino` folder

- Step 3. Open the `.ino` file with your Arduino IDE. The whole project will open in the Arduino IDE.

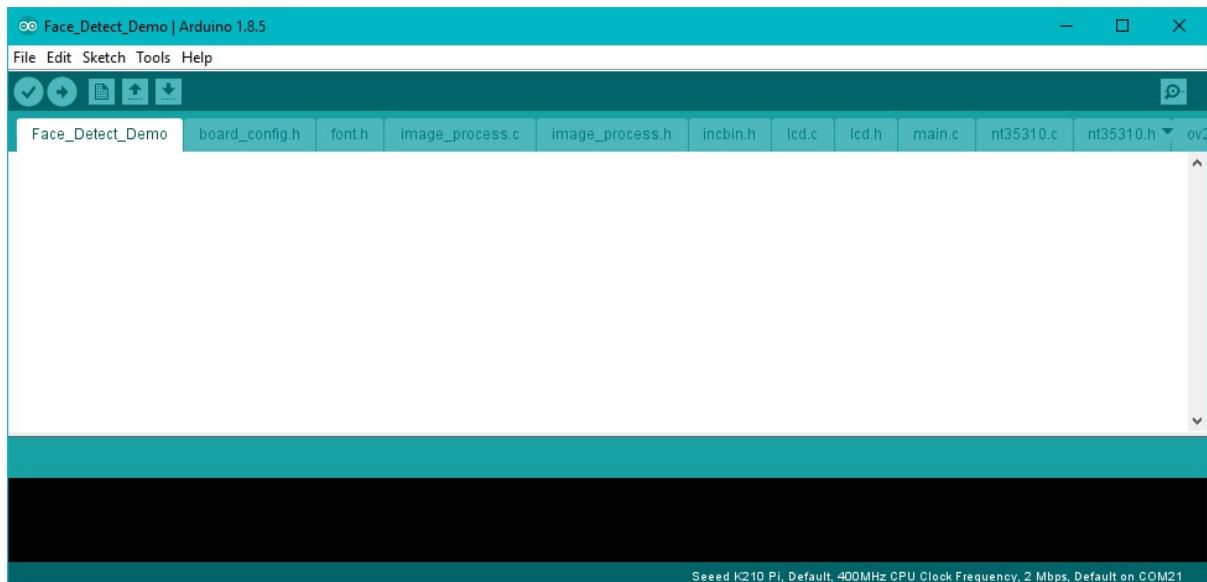


Figure 25. Open the .ino file with Arduino IDE

- Step 4. Board Config. Before building, we need to config the camera and LED. In this demo, we use OV2604 and Grove AI Hat.

The code for Grove AI Hat is **BOARD_LICHEEDAN**, so we need to config as below:

```

Face_Detect_Demo - board_config.h | Arduino 1.8.5
File Edit Sketch Tools Help
board_config.h font.h image_process.c image_process.h incbin.h lcd.c lcd.h main.c nt35310.c nt35310.h ov2

#ifndef _BOARD_CONFIG_
#define _BOARD_CONFIG_

#define OV5640 0
#define OV2640 1

#define BOARD_KD233 0
#define BOARD_LICHEEDAN 1

#if OV5640 + OV2640 != 1
#error ov sensor only choose one
#endif

```

Figure 26. Board Config

- Step 5. Build the main.c, please make sure you have selected the right board and flasher. K-flash/Seeed k210 Pi/

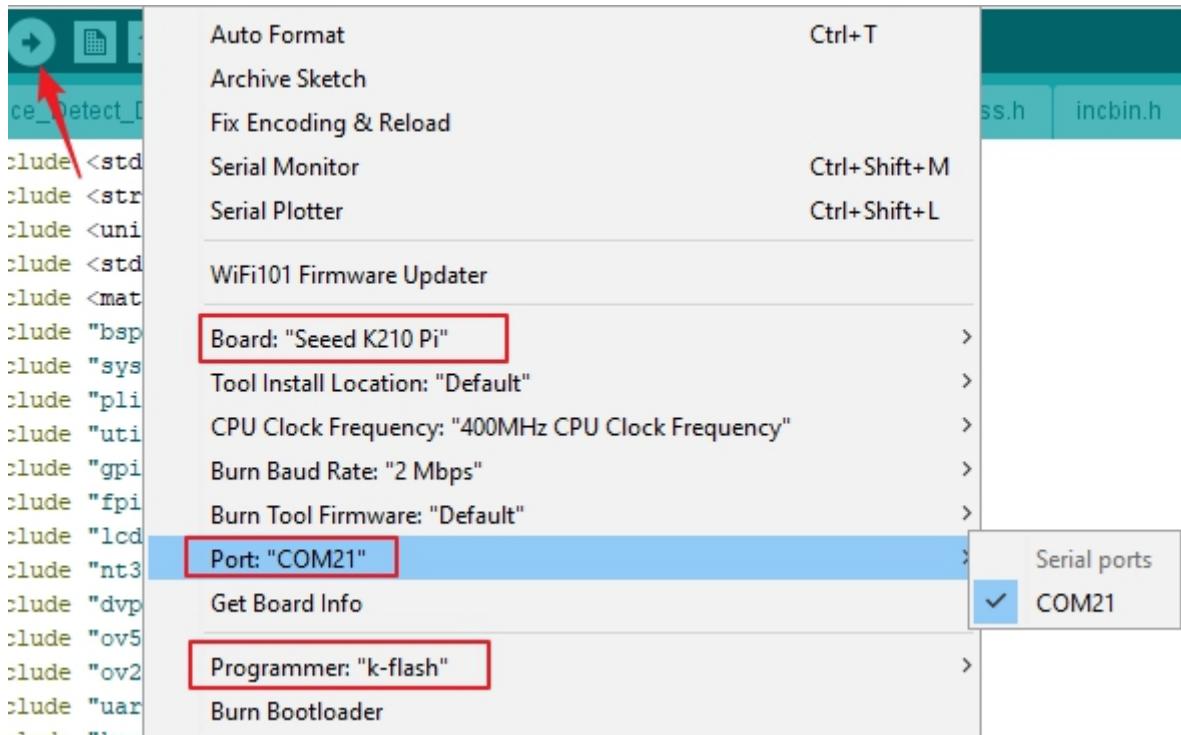


Figure 27. Board Select

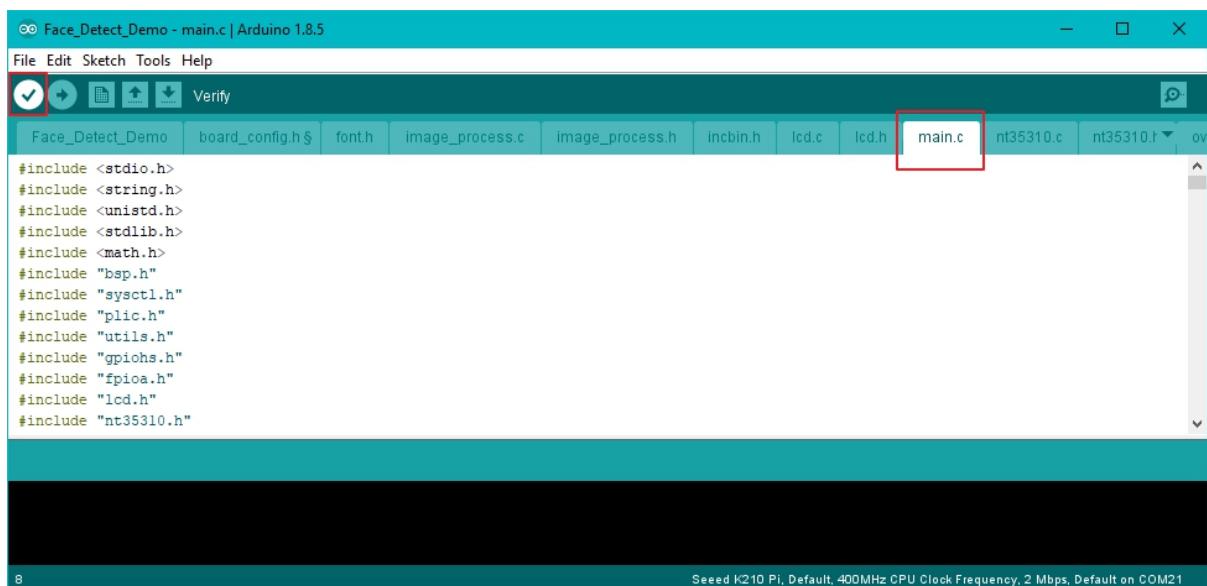


Figure 28. Build the main.c

- Step 6. Download the face_detect_demo into your Grove AI Hat. When the downloading is success, you can see as below:

```
#ifndef _BOARD_CONFIG_
#define _BOARD_CONFIG_
```

Done uploading.

Downloading ISP: |=====| 50.5% 8KiB/s

Downloading ISP: |=====| 98.5% 8KiB/s

Downloading ISP: |=====| 100.0% 8KiB/s

[INFO] Booting From 0x80000000

[INFO] Wait For 0.1 second for ISP to Boot

[INFO] Boot to Flashmode Successfully

[INFO] Selected Baudrate: 2000000

[INFO] Baudrate changed, greeting with ISP again ...

[INFO] Boot to Flashmode Successfully

[INFO] Selected Flash: On-Board

[INFO] Initialization flash Successfully

Programming BIN: |=====| 50.0%

Programming BIN: |=====| 100.0% 65KiB/s

[INFO] Rebooting...

Figure 29. Success

Now you can use the camera to shoot faces, rotate the focus ring on the camera or adjust the distance from the camera to the face to make the face clear. A red box appears when it recognizes a face.

Resources

- [\[PDF\] Grove AI HAT for Edge Computing Schematic file](#)
- [\[PDF\] Accelerometers_Sensor_datasheet Datasheet](#)
- [\[PDF\] ADS1115 Datasheet](#)