InGateway Documentation

Release 0.0.1

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Developer Guide

CHAPTER 1

InGateway Documentation Site Navigation

The InGateway series of Beijing InHand Networks Technology Co., Ltd. (InHand) consists of InGateway902 and InGateway501.

MobiusPi is a secondary development platform for the InGateway series.

1.1 Quick Start for MobiusPi Python Development

The InGateway series of Beijing InHand Networks Technology Co., Ltd. (InHand) consists of InGateway902 (referred to as **IG902** hereinafter), InGateway502 (referred to as **IG502** hereinafter) and InGateway501 (referred to as **IG501** hereinafter). MobiusPi is a secondary development platform for the InGateway series. This document describes how to perform Python-based secondary development on MobiusPi.

1.1.1 1. Build a MobiusPi development environment

Before starting development, ensure that you get the following items ready:

- InGateway
  - InGateway501
    - Firmware version: V2.0.0.r12351 or later
    - SDK version: py2sdk-V1.3.4 or later
    - The network is connected and the debugging mode is enabled.
  - InGateway502
    - Firmware version: V2.0.0.r13771 or later
    - SDK version: py3sdk-V1.3.5 or later
    - The network is connected and the debugging mode is enabled.
  - InGateway902
    - Firmware version: V2.0.0.r12537 or later
    - SDK version: py3sdk-V1.3.5 or later
    - The network is connected and the debugging mode is enabled.
- PC
  - Python 2.7.X/3.7.X interpreter
  - Visual Studio Code software
    - Python plug-in
    - Project Templates plug-in
    - SFTP plug-in
  - OpenSSH

If your MobiusPi and PC have met all the above items, skip this section. Otherwise, prepare a development environment as follows.

- *1.1 Prepare the hardware and network environment*
- *1.2 Prepare the PC environment*
- *1.3 Prepare the VS Code development environment*

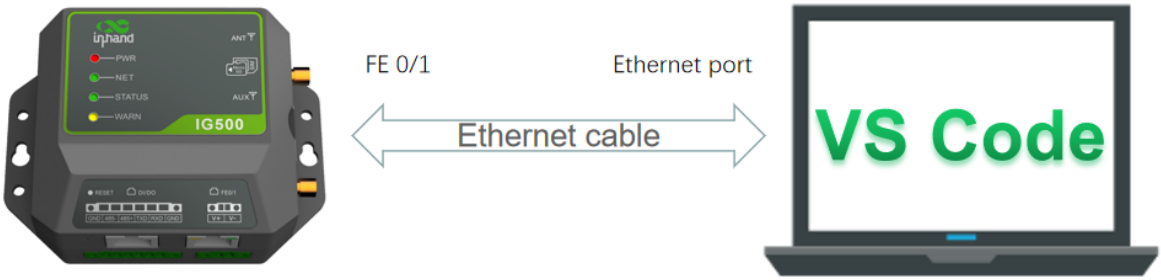
1.1 Prepare the hardware and network environment

- *1.1.1 Connect the power supply and use a network cable to connect the platform to the PC*

1.1.1 Connect the power supply and use a network cable to connect the platform to the PC

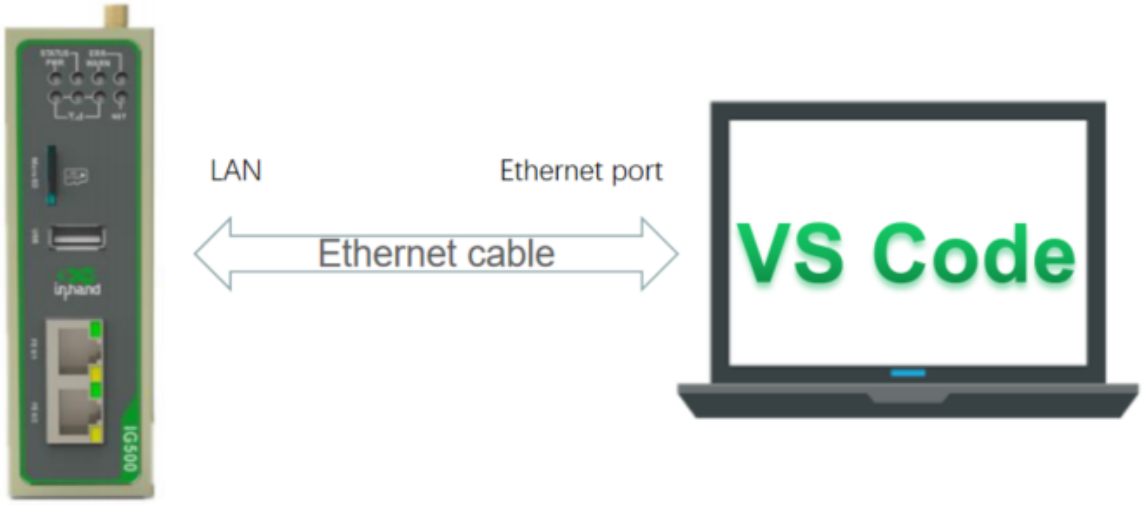
- Prepare the IG501 hardware

  Power on IG501 and connect the PC and IG501 through an Ethernet cable according to the topology.



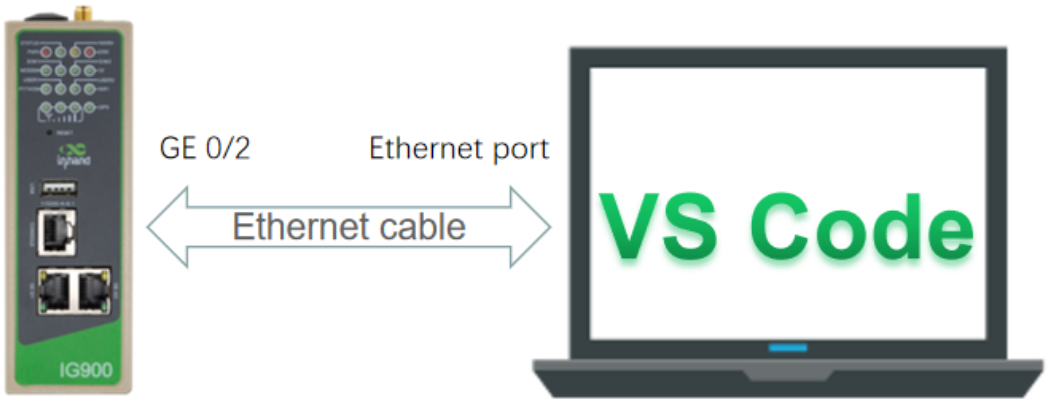
- Prepare the IG502 hardware

  Power on IG502 and connect the PC and IG502 through an Ethernet cable according to the topology.



- Prepare the IG902 hardware

  Power on IG902 and connect the PC and IG902 through an Ethernet cable according to the topology.



1.1.2 Acess the MobiusPi

- Acess the IG501 by referring to Access the IG501.
- Acess the IG902 by referring to Access the IG902.

1.1.3 Connect MobiusPi to the Internet

- Connect IG501 to the Internet by referring to Connect IG501 to the Internet.
- Connect IG502 to the Internet by referring to Connect IG502 to the Internet.
- Connect IG902 to the Internet by referring to Connect IG902 to the Internet.

1.1.4 Update the software version

If you want to get the latest MobiusPi and its functional characteristics, please visit the Resource. To update the software version, see the following links:

- Update the IG501 software version
- Update the IG502 software version
- Update the IG902 software version

1.1.5 Enable the debugging mode for MobiusPi

To run and debug Python code on MobiusPi during development, you need to enable the debugging mode for MobiusPi.

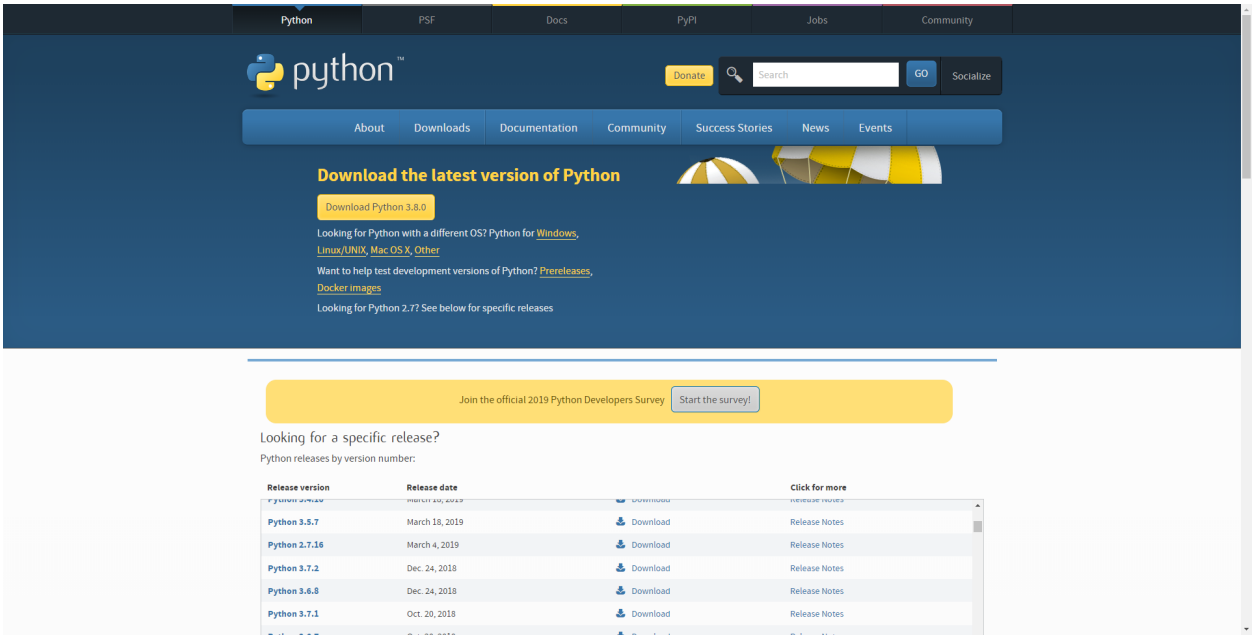
- Enable the IG501 debugging mode
- Enable the IG502 debugging mode

- Enable the IG902 debugging mode

1.2 Prepare the PC environment

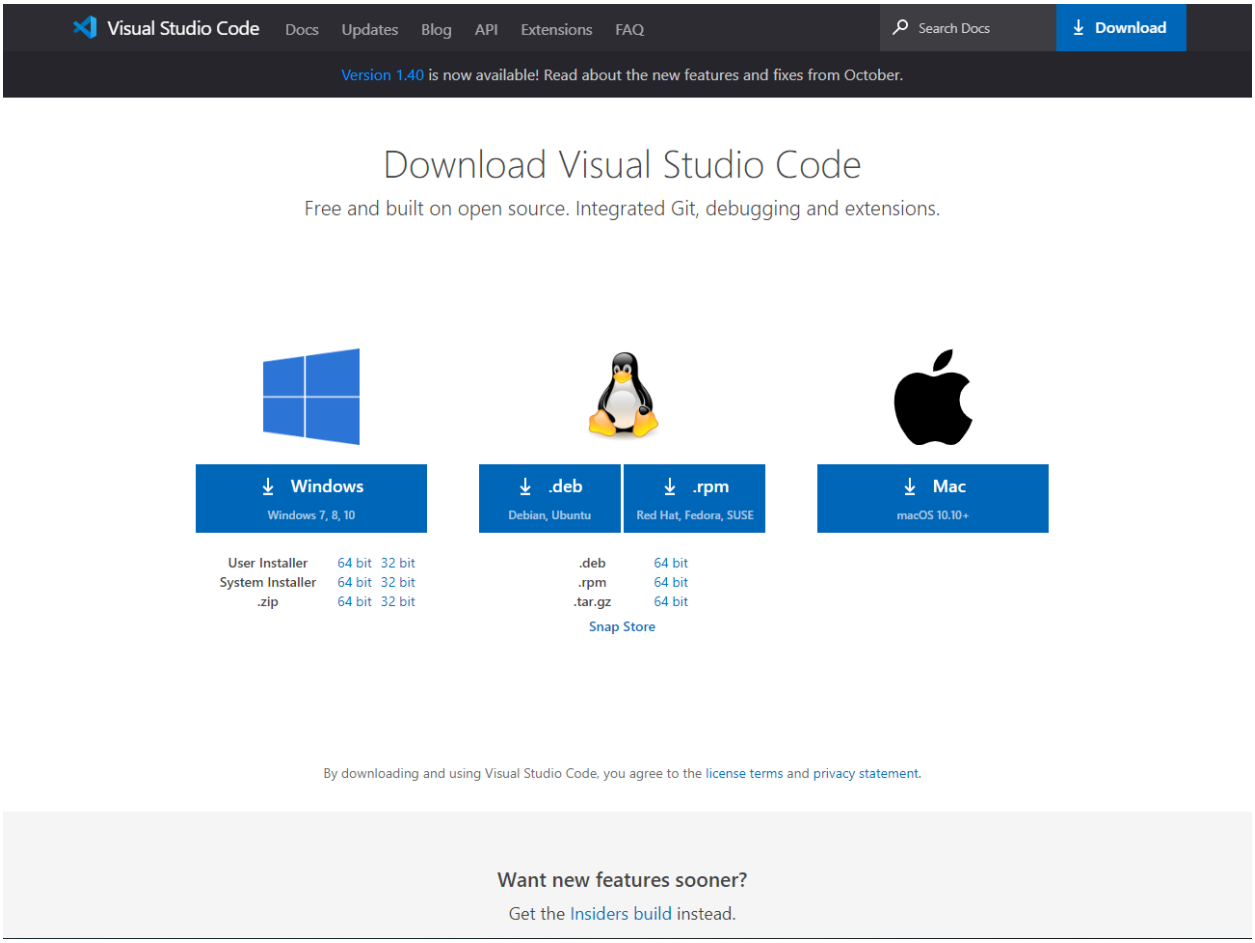
1.2.1 Install the Python interpreter

The PC shall be installed with the Python2.7.X or 3.7.X interpreter (the 3.7.X interpreter is recommended). You can download the install package from https://www.python.org/downloads/ and install it to the PC.

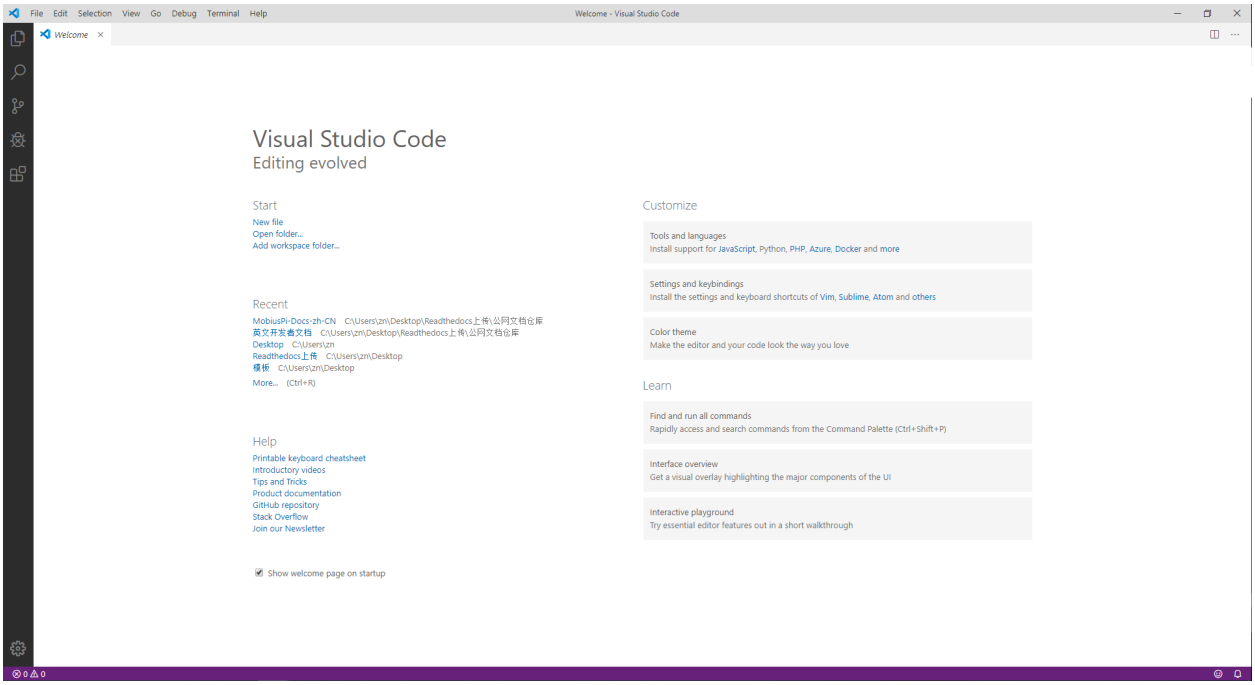


1.2.2 Install Visual Studio Code

You can download Visual Studio Code (VS Code) from https://code.visualstudio.com/Download.

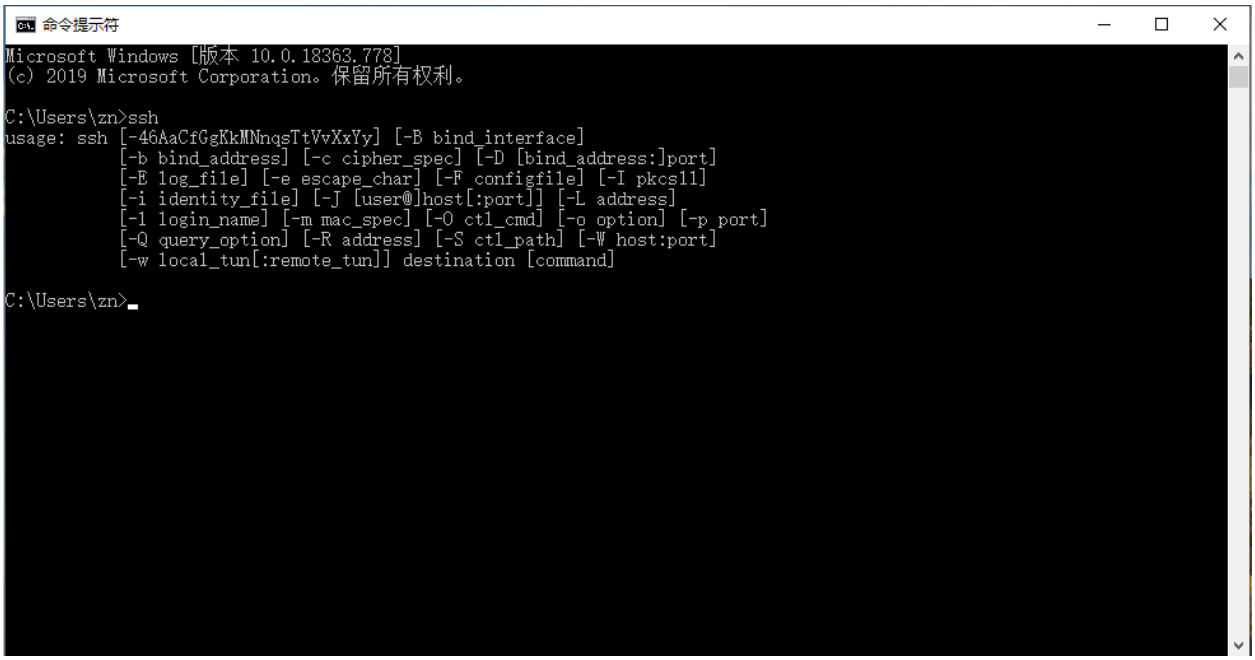


After VS Code is downloaded and installed, run the software, and its page is as follows.



1.2.3 Install OpenSSH

You can enter the `ssh` command in Command Prompt to check whether the PC supports the SSH protocol. If the PC supports the SSH protocol, the following figure is displayed:



If the PC does not support the SSH protocol, download OpenSSH from https://www.openssh.com and install it to the PC.

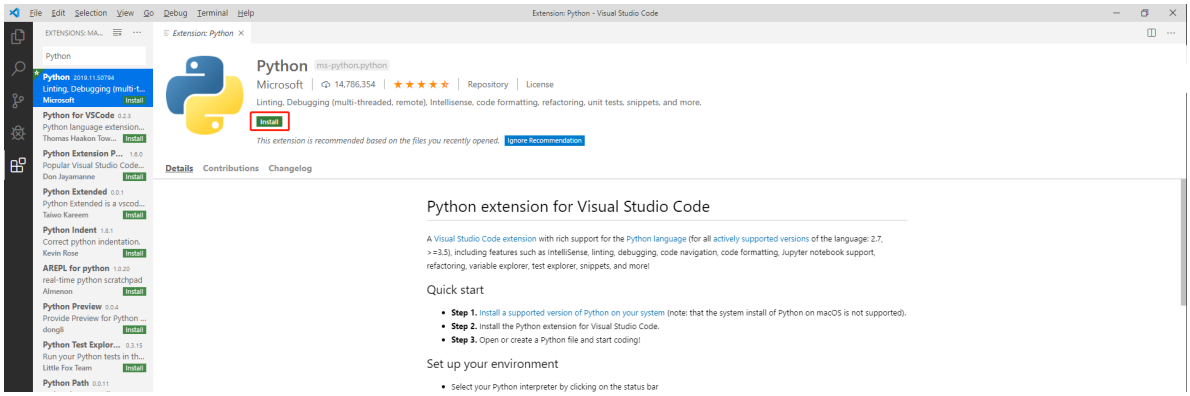
1.3 Prepare the VS Code development environment

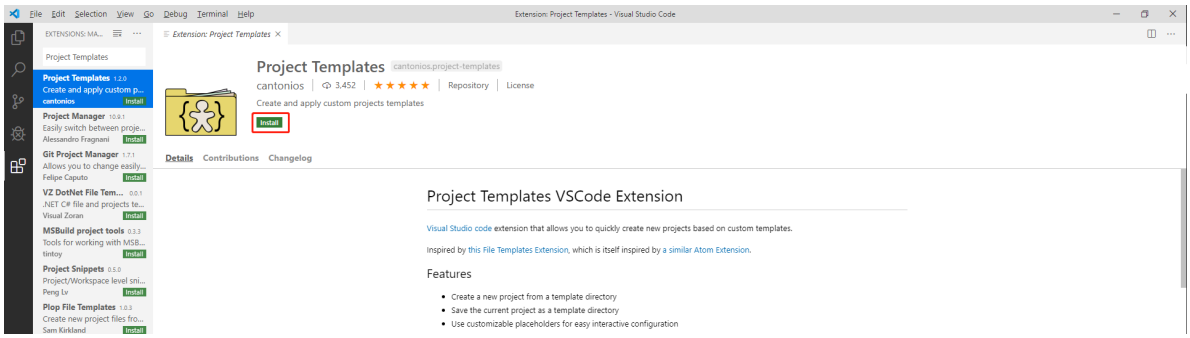
1.3.1 Install the VS Code extension

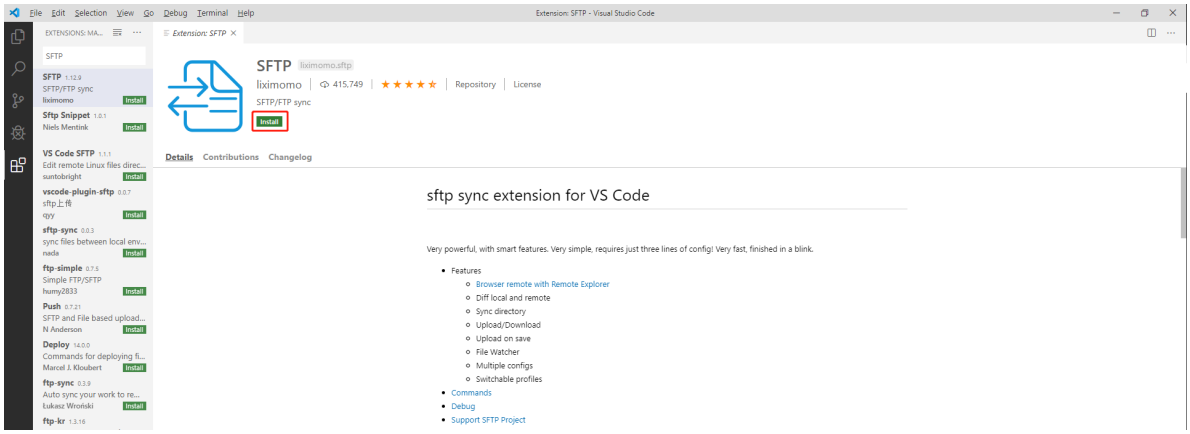
To develop and debug the Python code on MobiusPi, you must install the following extensions in Extensions of VS Code IDE:

- `Python` is a VS Code Python extension. It provides rich features, including IntelliSense, Linting, debugging, code navigation and formatting, support to Jupyter notebook, restructuring, variable resource manager, test resource manager, and code snippets. For more information, see its official website.

- `Project Templates` is a VS Code extension that allows you to quickly create new projects based on a custom template. InHand will release multiple Python App templates. You can use Project Templates to import a template and initialize your project quickly.
- `SFTP` allows you to use the SFTP Sync plug-in to upload the code to MobiusPi.



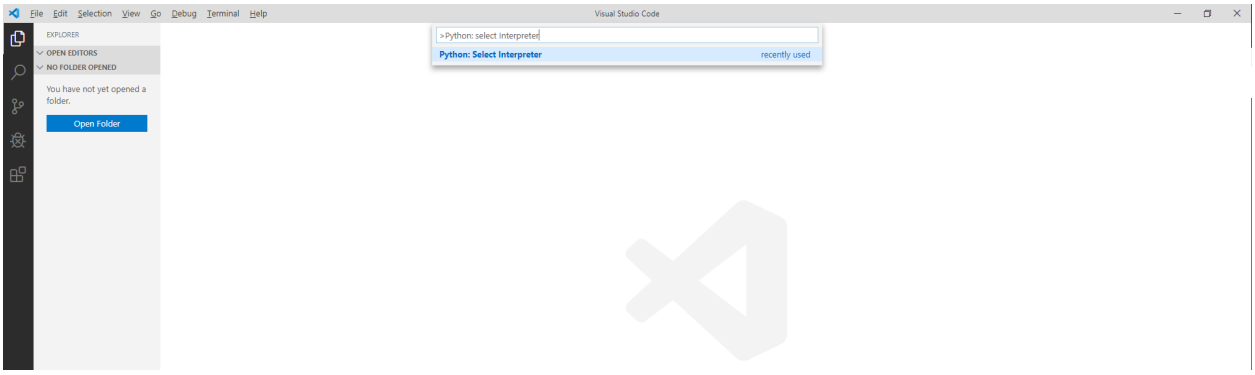




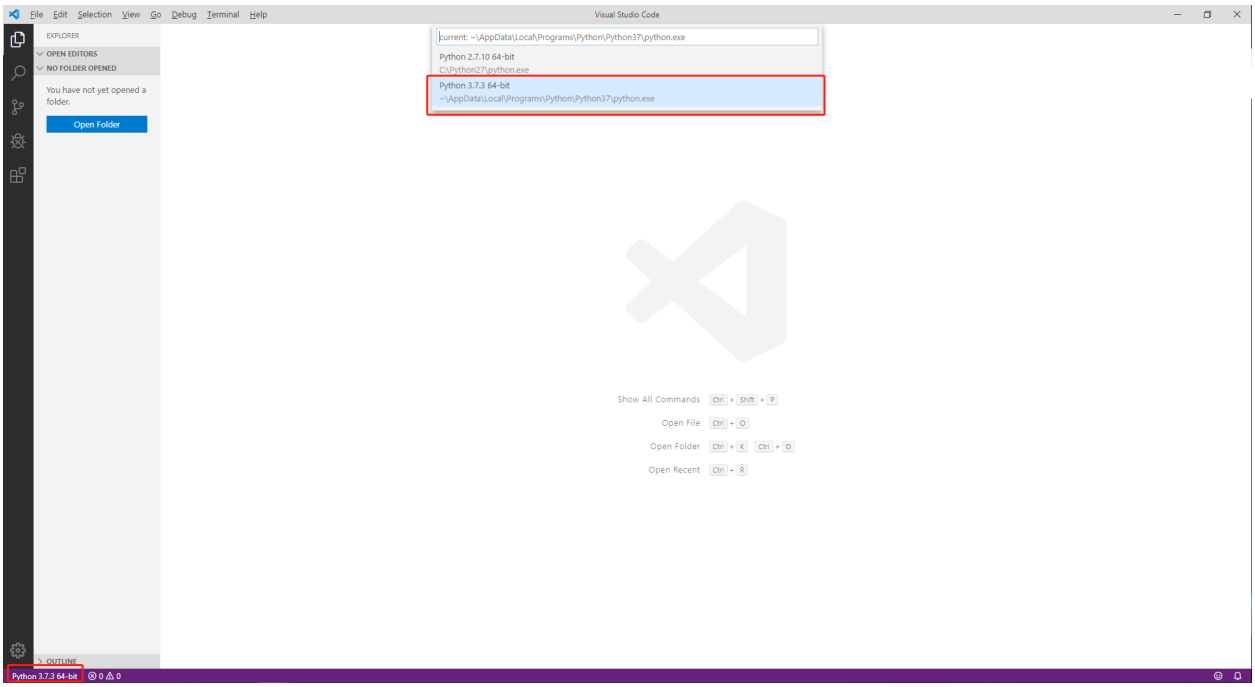
Now, all plug-ins required by MobiusPi have been installed. For more information about VS Code plug-ins, see the Visual Studio Code official website.

1.3.2 Configure the Python interpreter version

Press `Ctrl+Shift+P`. On the displayed Command Palette, enter `>Python: select Interpreter`.



Select a required Python interpreter. In this document, the Python 3.7.X interpreter is used. The selected 3.7.X version shall be consistent with that on the **Edge Computing > Python Edge Computing** page. Then, the selected Python interpreter version is displayed in the lower-left corner of VS Code.

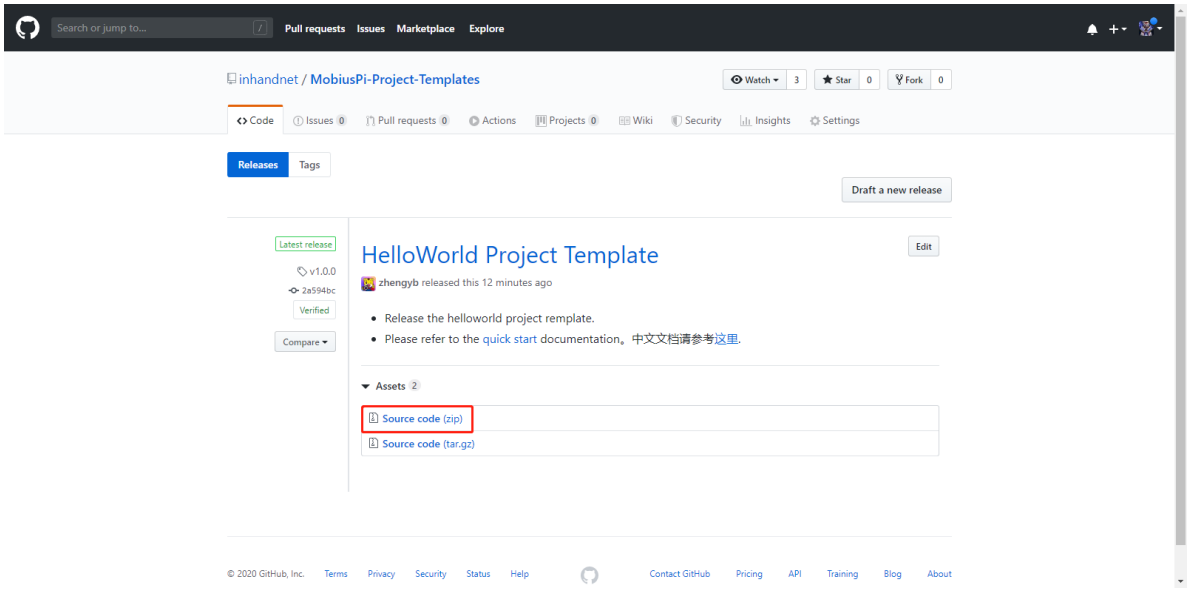


1.3.3 Configure the project template

1.3.3.1 Apply the InHand standard project template

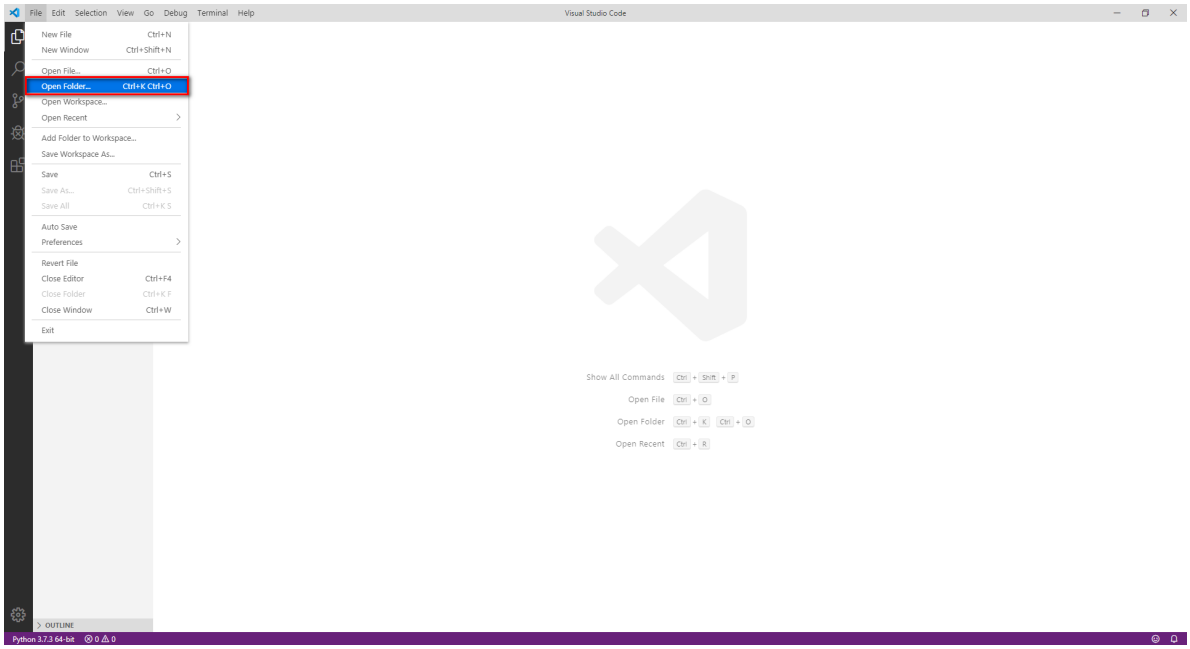
- Step 1: Click Here to download a MobiusPi project template.

  MobiusPi provides multiple project templates for you to quickly initialize your project directory. For more information about each project template, see README.md. In this document, the standard project template **helloworld-template** is used as an example.



- Step 2: Open the project template.

  Decompress the downloaded project template package, use VS Code to open the helloworld-template folder in the decompressed package, choose **Files > Open Folder**, and select the decompressed **helloworld-template** folder.



The following figure shows the opened project template folder **helloworld-template**. The project template contains the following information:

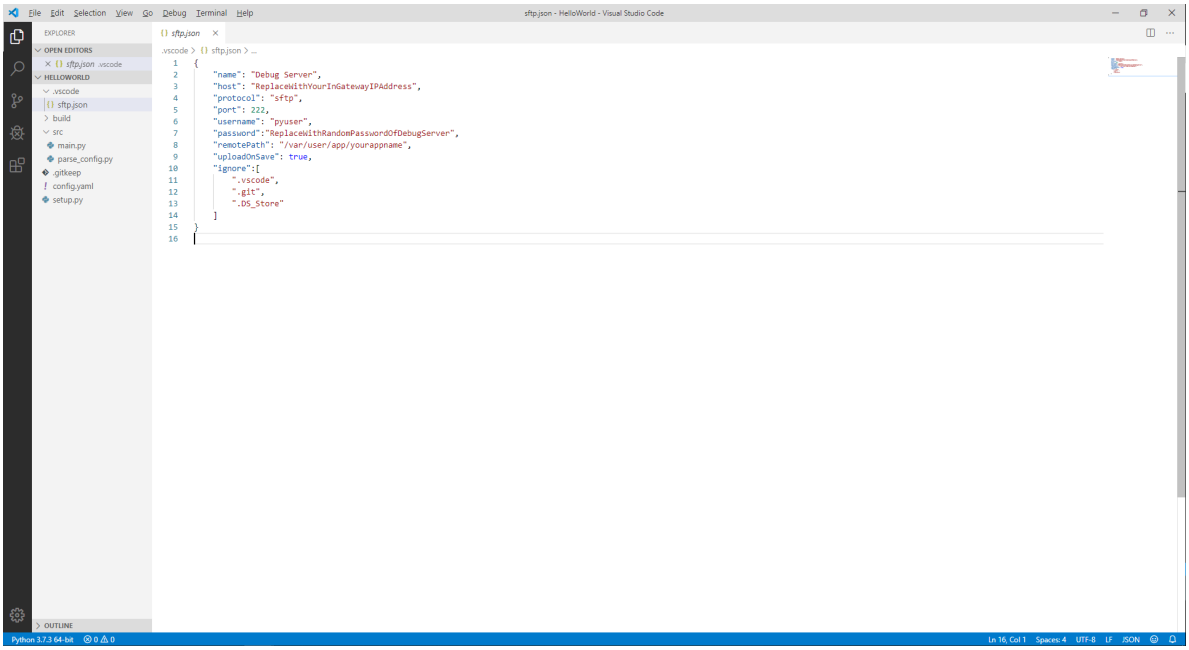
```
.vscode
   sftp.json
build
```

(continues on next page)

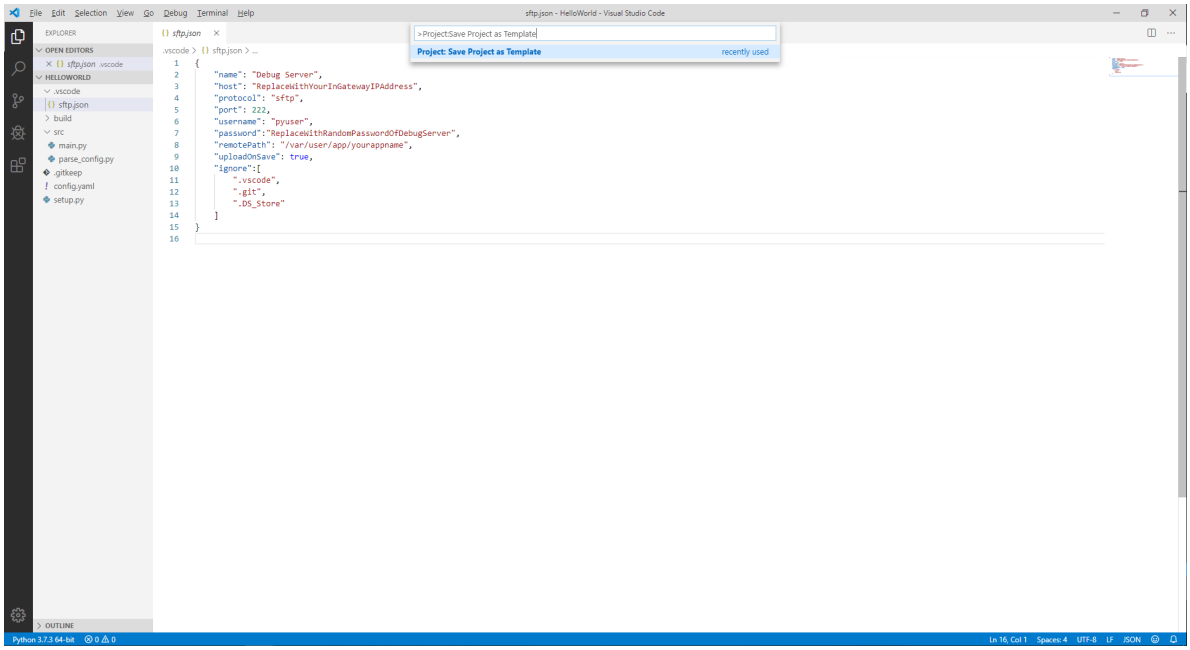
(continued from previous page)

```
lib
src
   main.py
   parse_config.py
config.yaml
setup.py
```

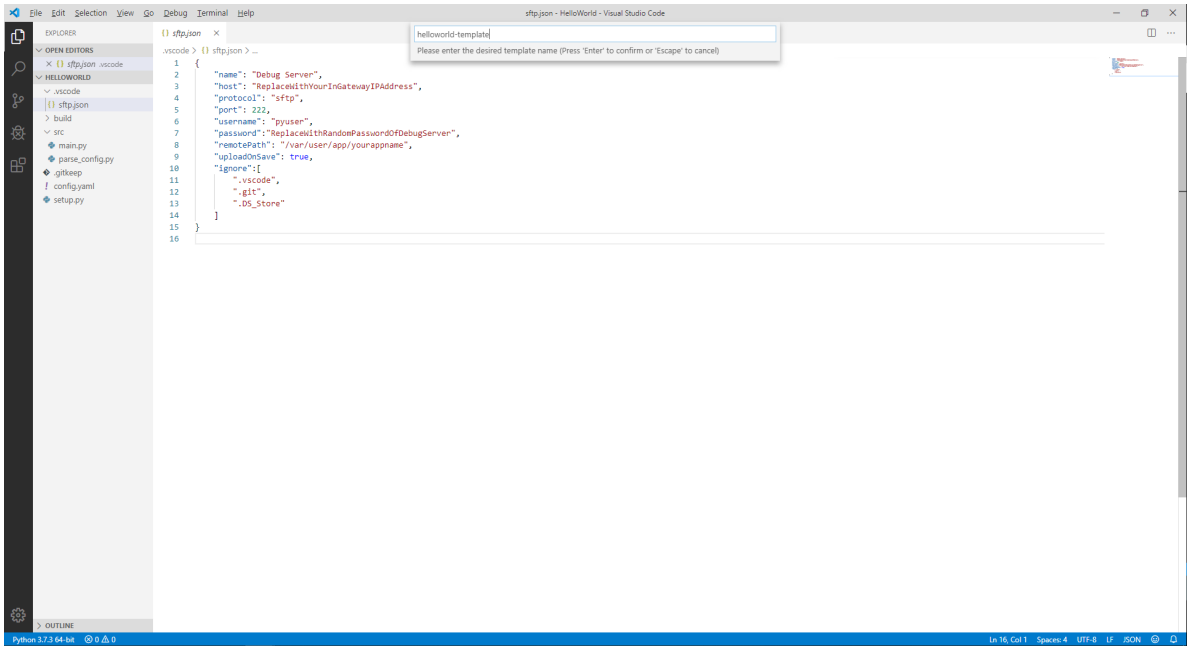
  - `.vscode`: The VS Code configuration folder.
    - `sftp.json`: The configuration file of the SFTP plug-in, which is used to connect to MobiusPi over SFTP.
  - `build`: The App release package folder.
  - `lib`: The folder of the App third-party dependency library.
  - `src`: The App source code folder.
    - `main.py`: The App entry.
    - `parse_config.py`: The App parsing configuration file.
  - `config.yaml`: The App configuration file.
  - `setup.py`: The App version, SDK version, and other information.



- Step 3: In the Command Palette, enter the `>Project:Save Project as Template` command to save the current project file as a template.



Enter a name for your template, such as helloworld-template.



1.3.3.2 Custom project template

- Step 1: Create a project template folder which must contain the following information. You can add other files as needed.

```
.vscode
  sftp.json
```

(continues on next page)

(continued from previous page)

```
build
src
   main.py
setup.py
```

  - `.vscode`: The VS Code configuration file. You can enter the `>SFTP:Config` command in the VS Code Command Palette to quickly create the .vscode folder and the sftp.json file.
    - `sftp.json`: The configuration file of the SFTP plug-in, which is used to connect to MobiusPi over SFTP.
  - `build`: The App release package folder.
  - `src`: The App source code folder.
    - `main.py`: The App entry.
  - `setup.py`: The App version, SDK version, and other information. We recommend that you define the information according to the standard template.

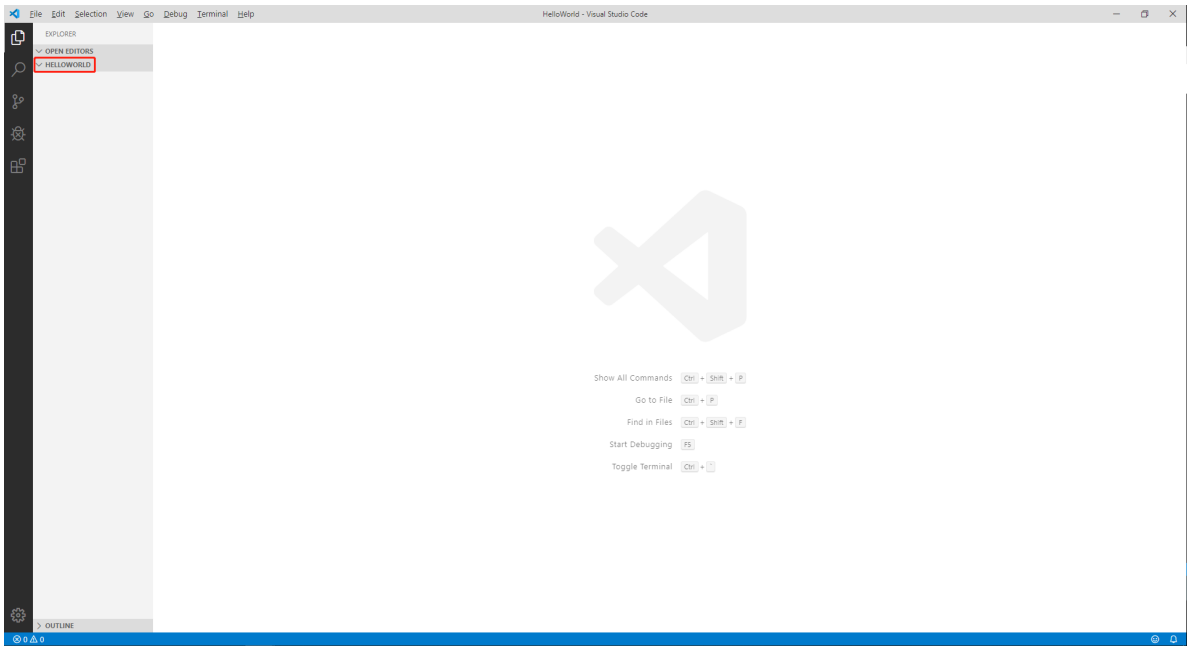
- Step 2: Use VS Code to open the custom project template folder, choose **Files > Open Folder**, and select the custom project template folder.
- Step 3: In the Command Palette, enter the `>Project:Save Project as Template` command to save the current project file as a template.

1.1.2 2. Compile the MobiusPi App: Hello World

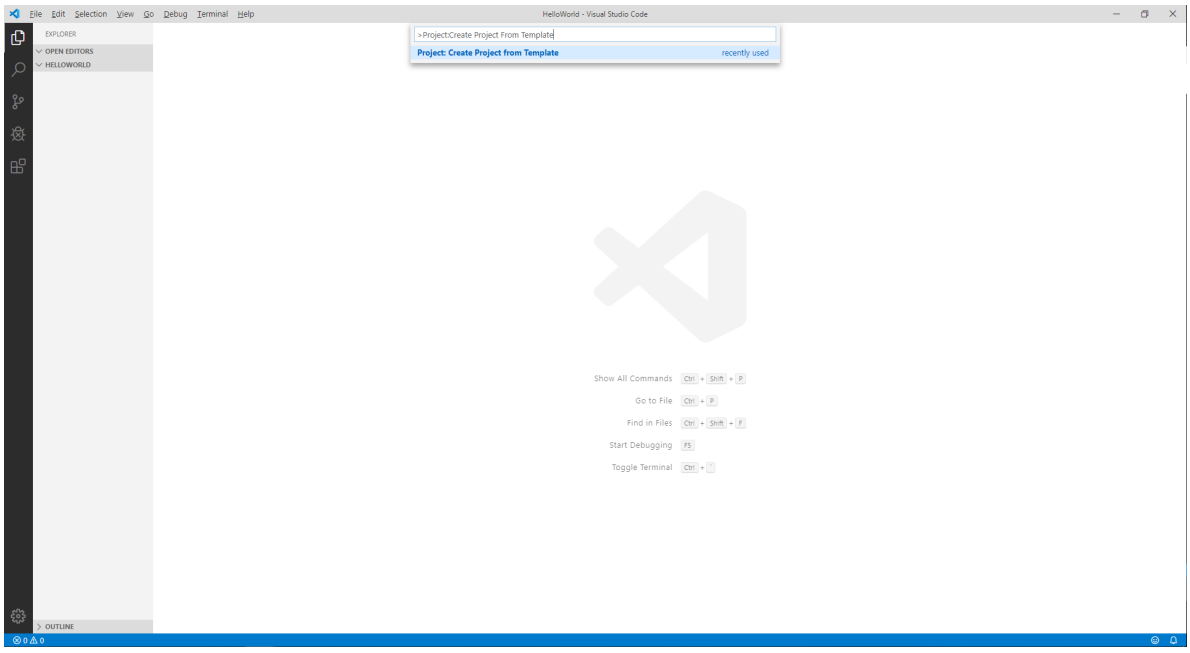
This document takes the **HelloWorld** App as an example to describe how to develop MobiusPi Python Apps in VS Code. This App can print a "hello world!" log every 10s in MobiusPi and allows you to import the configuration file and modify the log.

2.1 Use a template to create a project

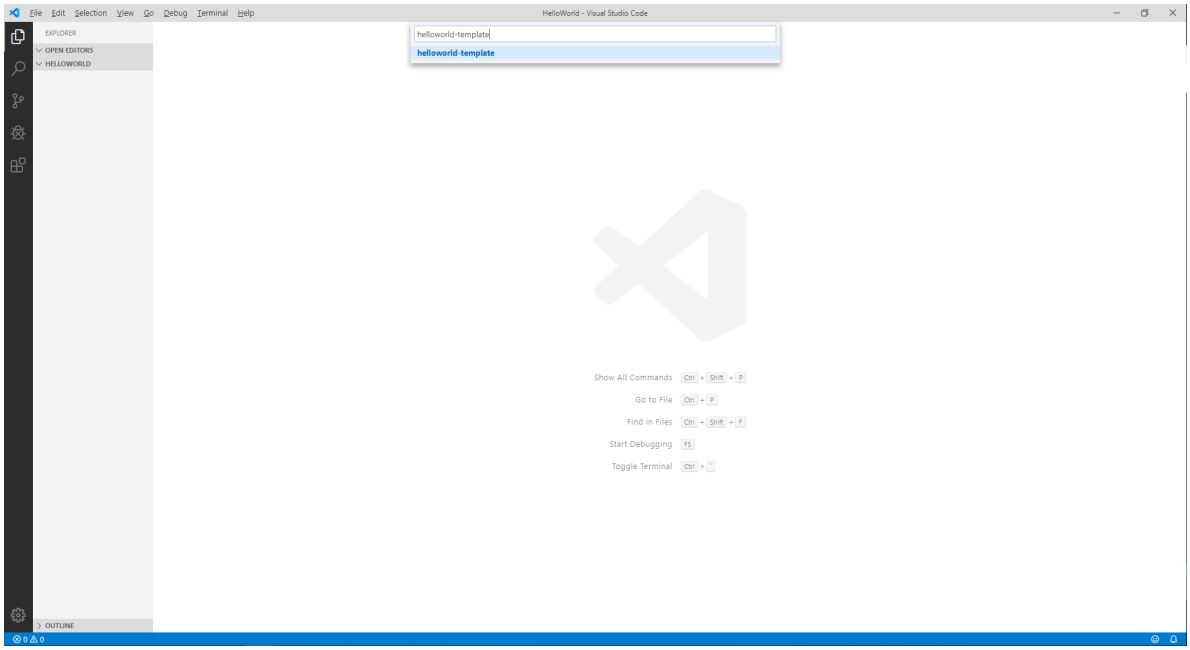
- Step 1: Use VS Code to open the project folder of the Python App. The following figure is displayed:



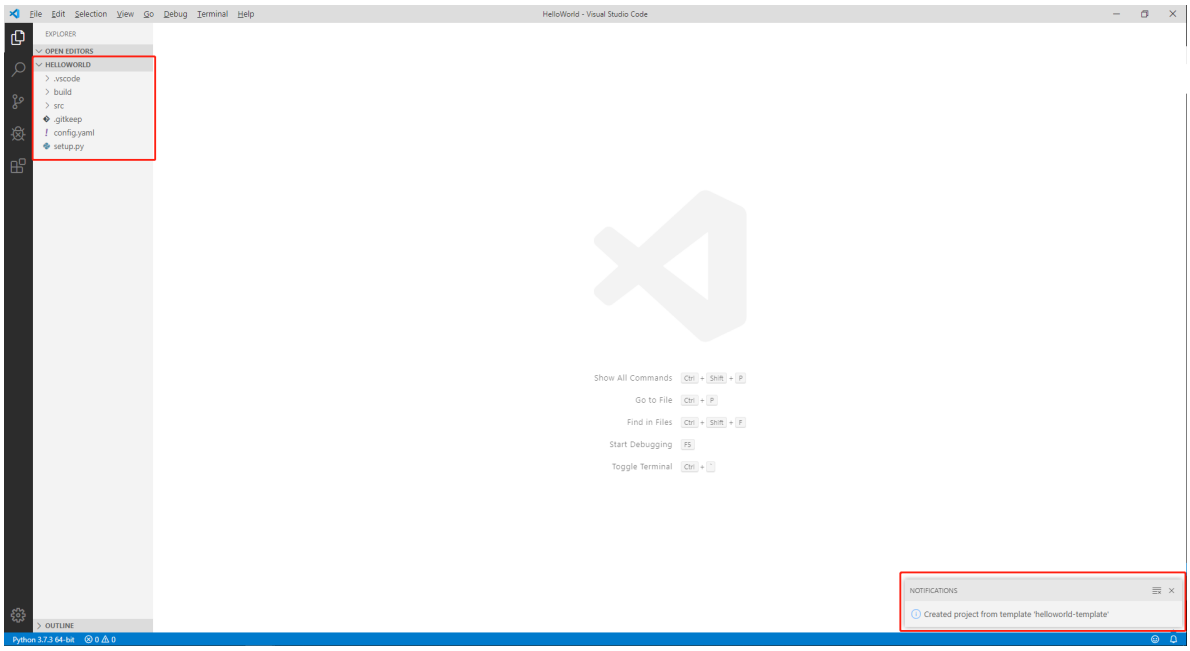
- Step 2: In the Command Palette, enter the `>Project:Create Project From Template` command to quickly create a project directory based on the existing template.



- Step 3: Enter the name of the helloworld-template, and press Enter.

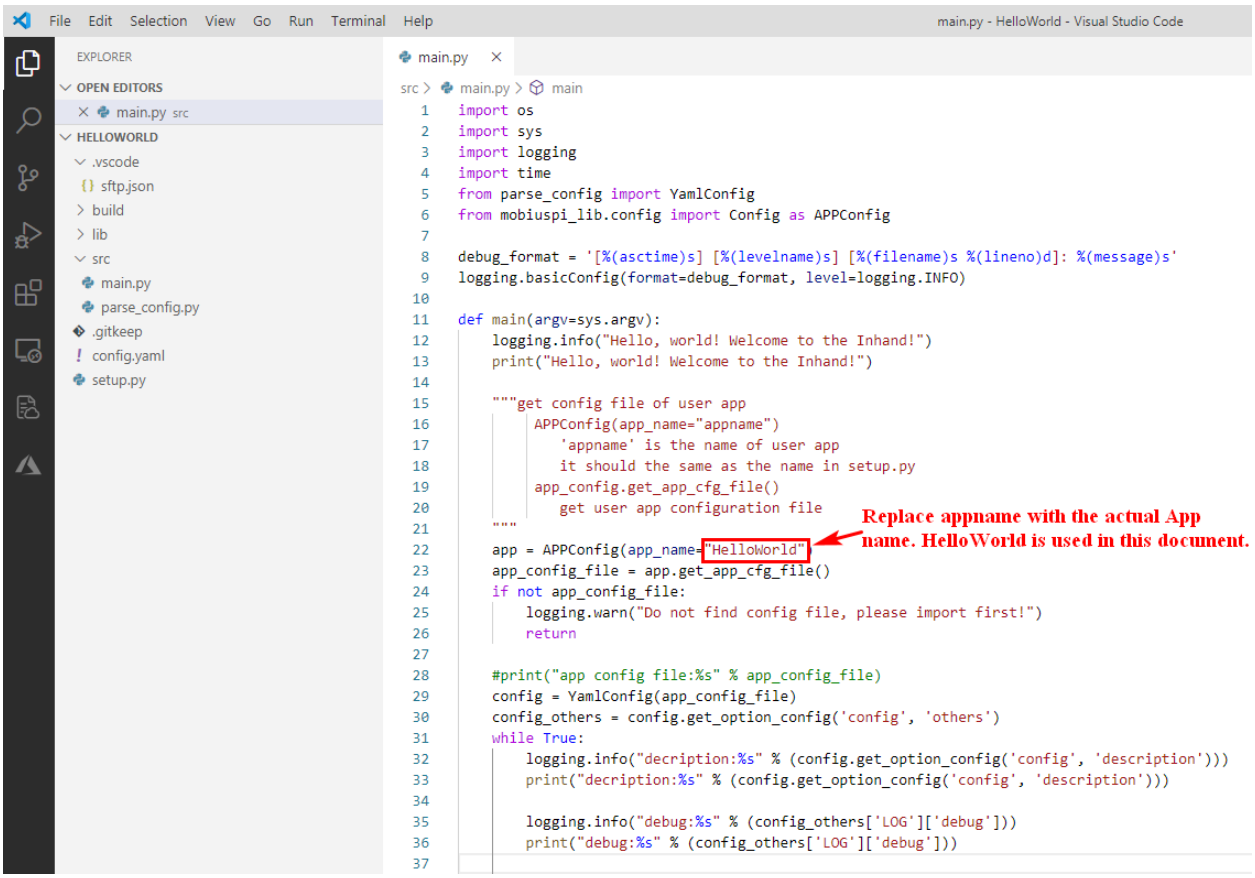


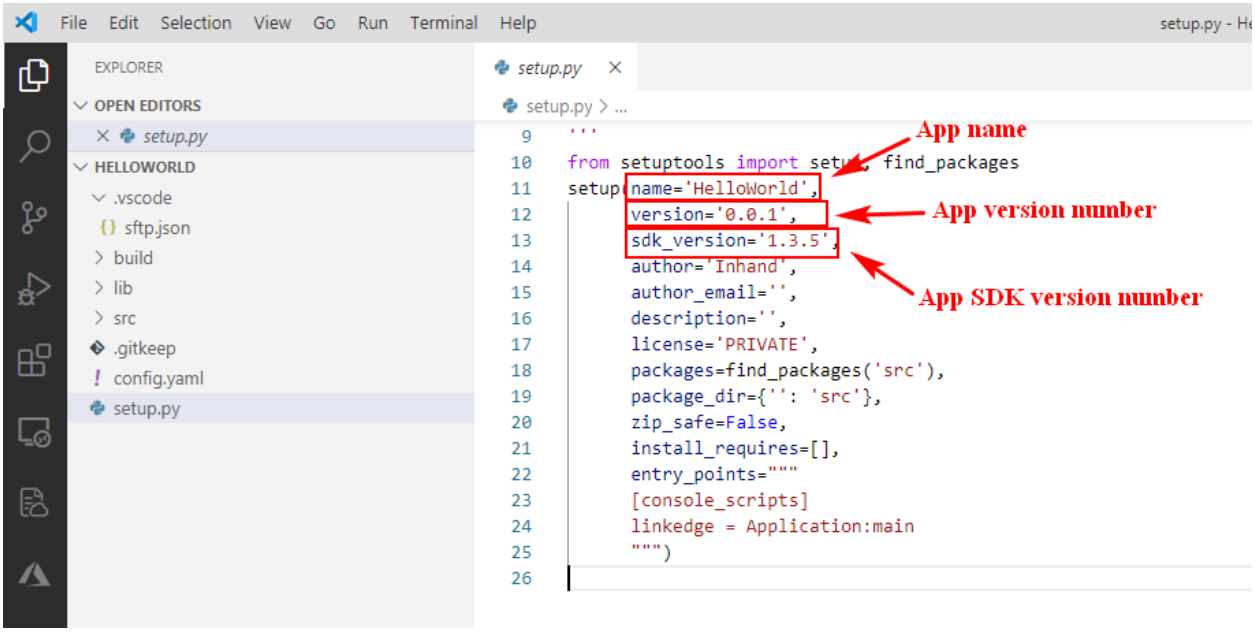
After the template is selected, VS Code automatically adds the file that you add in the template to the folder of the current project.



2.2 Encoding

The standard project template **helloworld-template** can print a "hello world!" log every 10s in MobiusPi and allows you to import the configuration file and modify the log. To modify the App name, modify the code in `main.py` and `setup.py` by referring to the following figure. Note: The Python App name cannot contain any space.





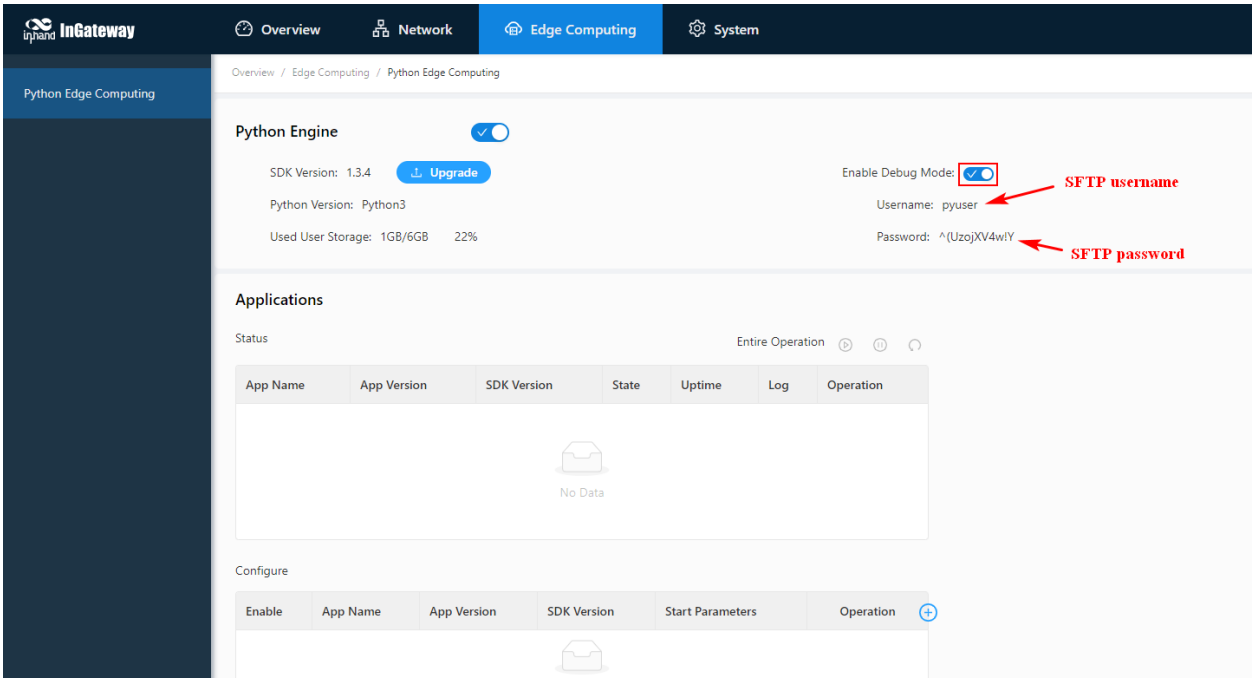
2.3 Debugging

- *2.3.1 Create an SFTP connection*

- *2.3.2 Debug the code*

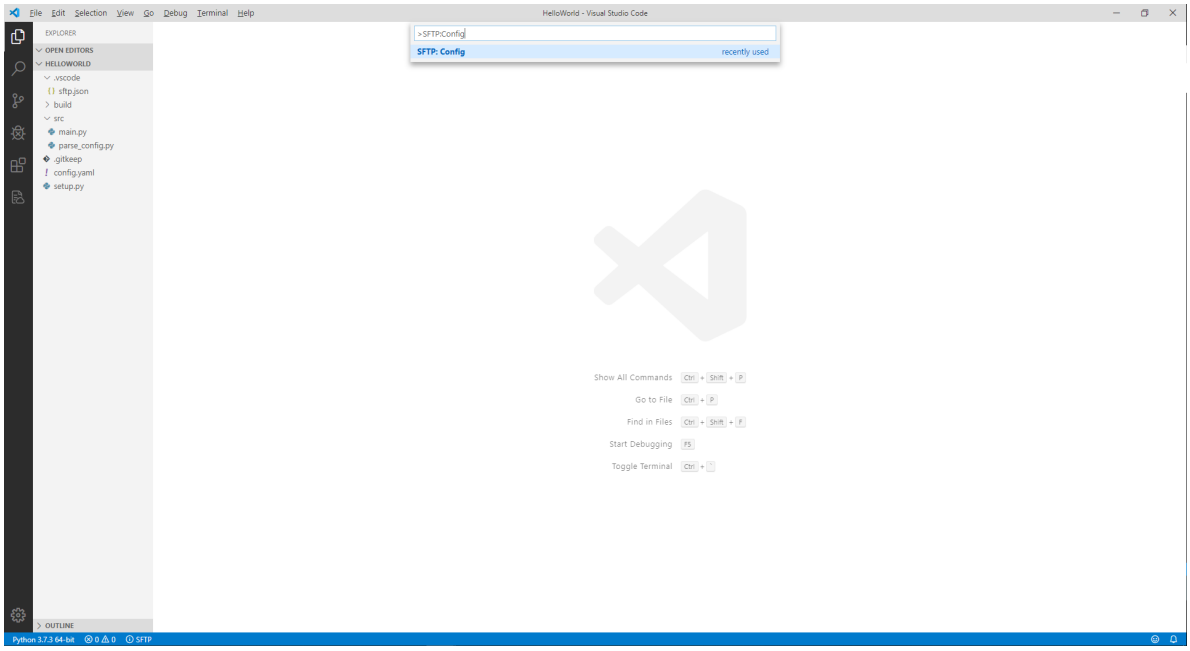
2.3.1 Create an SFTP connection

To debug the code remotely, upload the local code to the remote server (MobiusPi). Before uploading the local code, ensure that the debugging mode has been enabled for MobiusPi. After the debugging mode is enabled, the following figure is displayed:



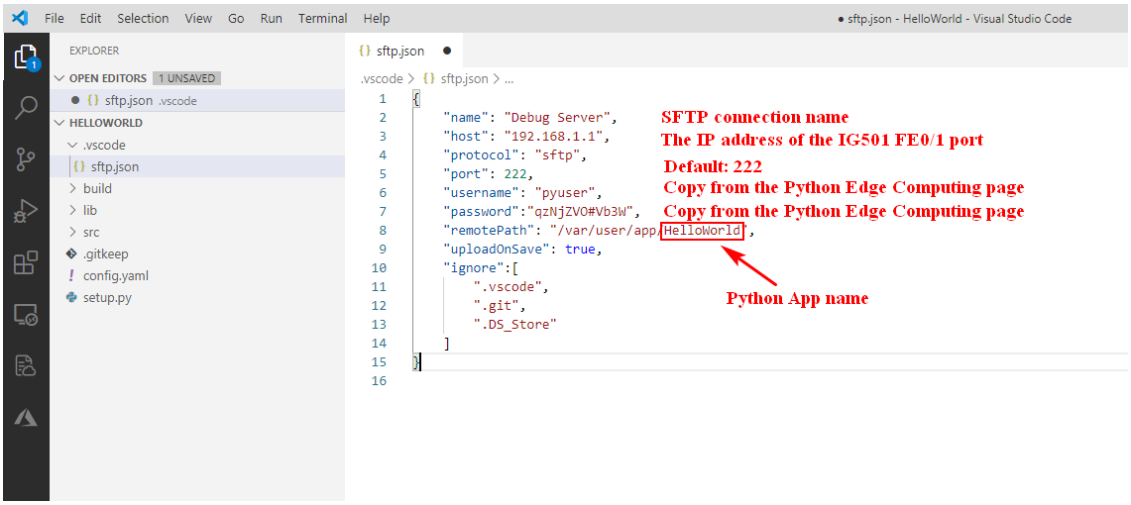
- Step 1: Open the `sftp.json` file.

  In the Command Palette, enter the `>SFTP:Config` command and then open the `sftp.json` file.



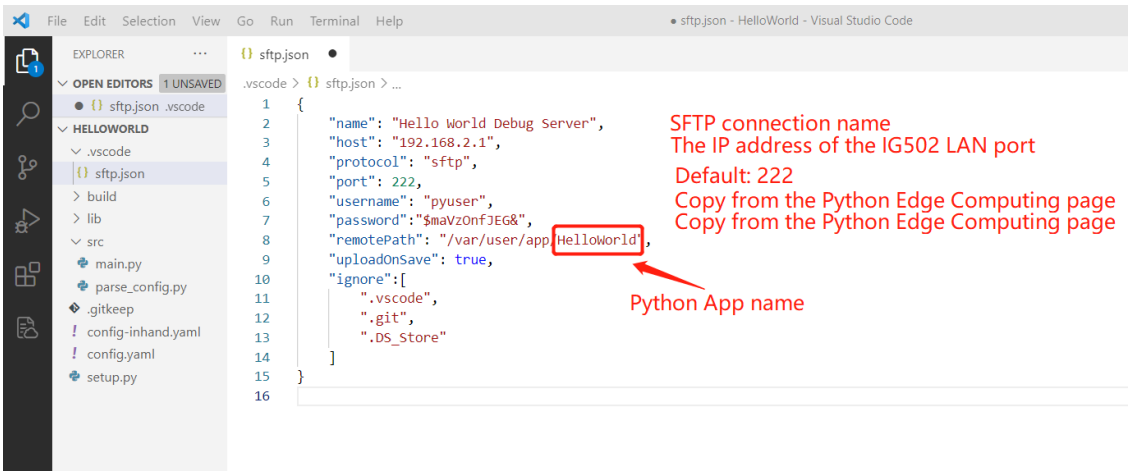
- Step 2: Configure the SFTP connection.
  - Configure the SFTP connection for IG501

    In the `sftp.json` file, configure the SFTP connection according to the connection parameters on the **Edge Computing > Python Edge Computing** page. Note: The Python App name must be same to that in `mian.py`.



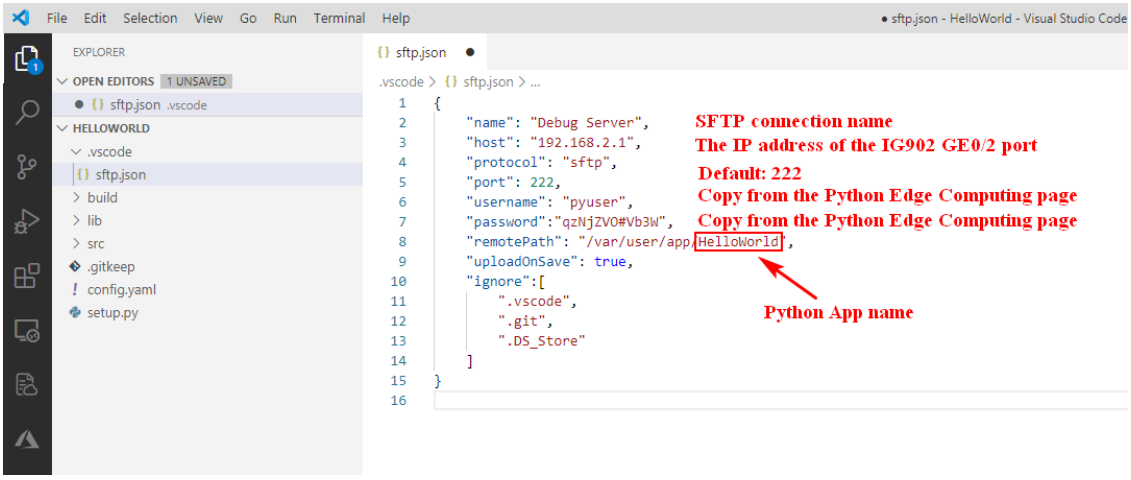
  - Configure the SFTP connection for IG502

    In the `sftp.json` file, configure the SFTP connection according to the connection parameters on the **Edge Computing > Python Edge Computing** page. Note: The Python App name must be same to that in `mian.py`.

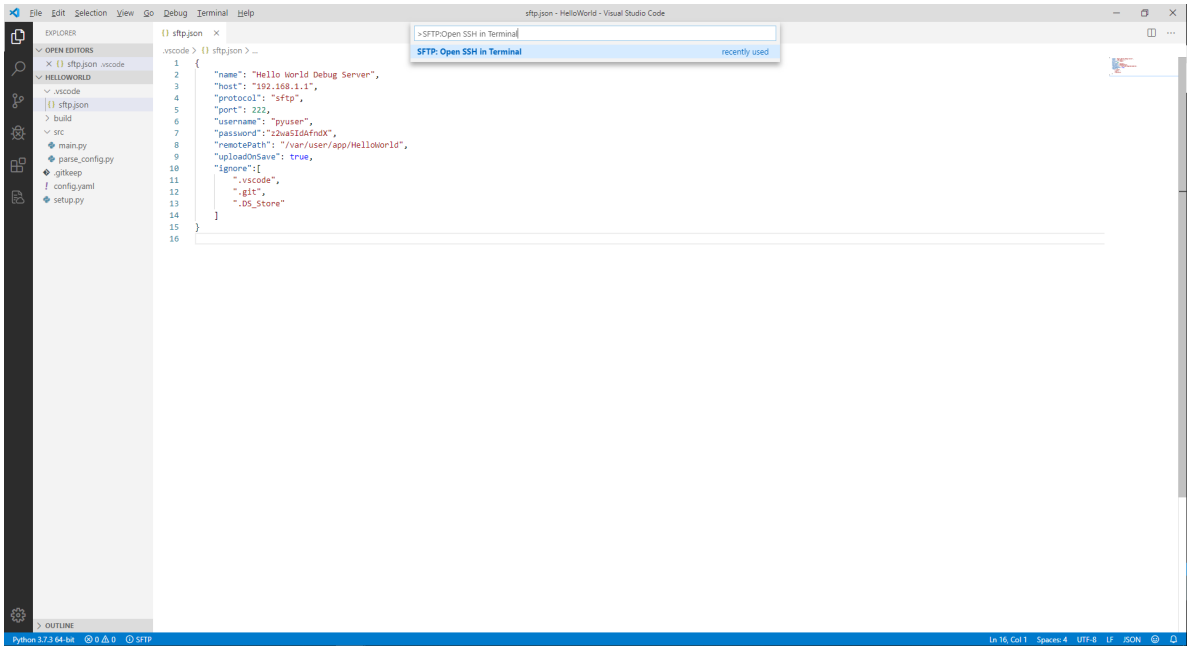


– Configure the SFTP connection for IG902

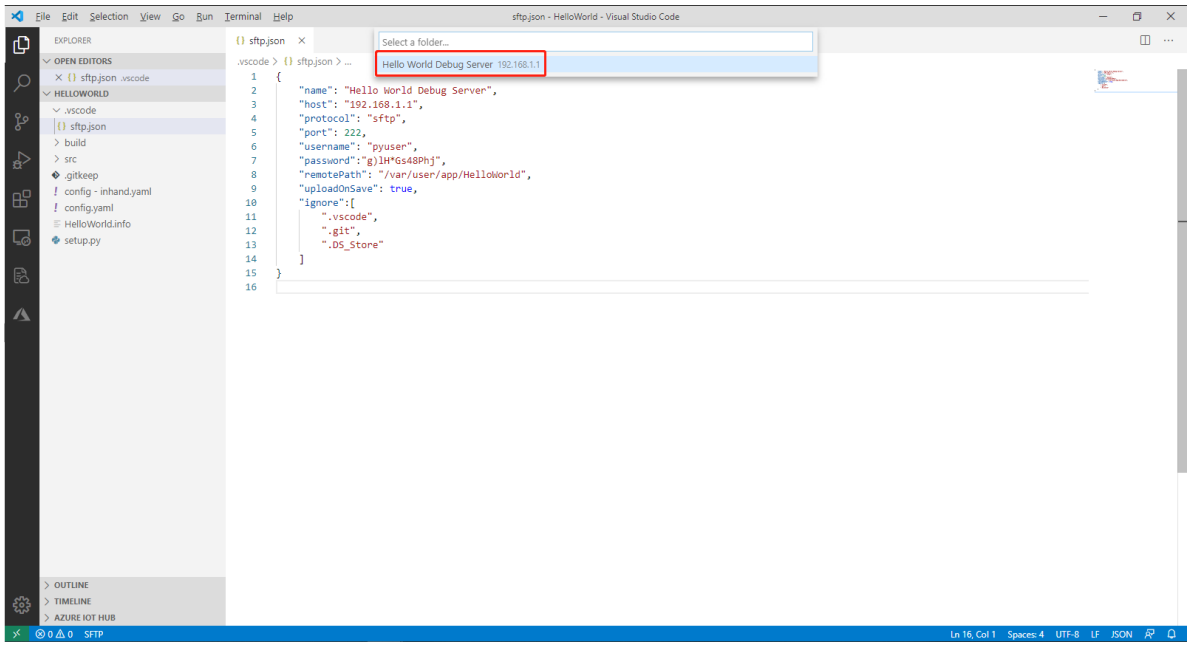
In the `sftp.json` file, configure the SFTP connection according to the connection parameters on the **Edge Computing > Python Edge Computing** page. Note: The Python App name must be same to that in `mian.py`.



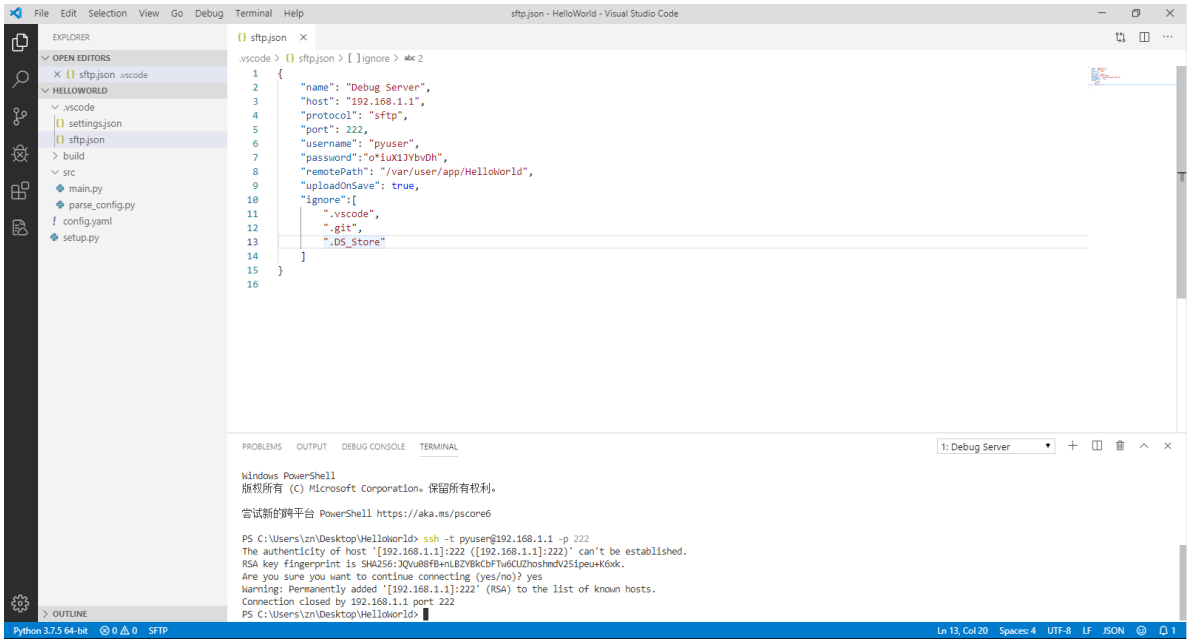
- Step 3: After the configuration is completed and saved, enter the `>SFTP:Open SSH in Terminal` command in the Command Palette to connect to the remote server.



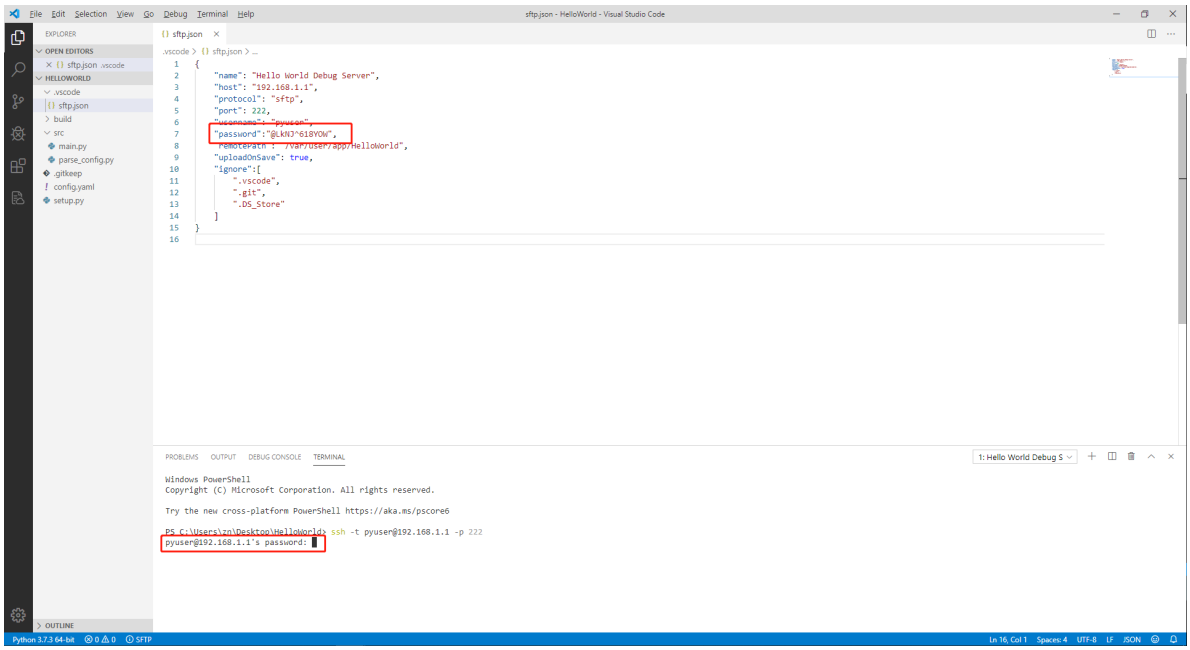
- Step 4: In the Command Palette, you are requested to select the SFTP server to be connected. Select the SFTP server in `sftp.json` and press Enter.



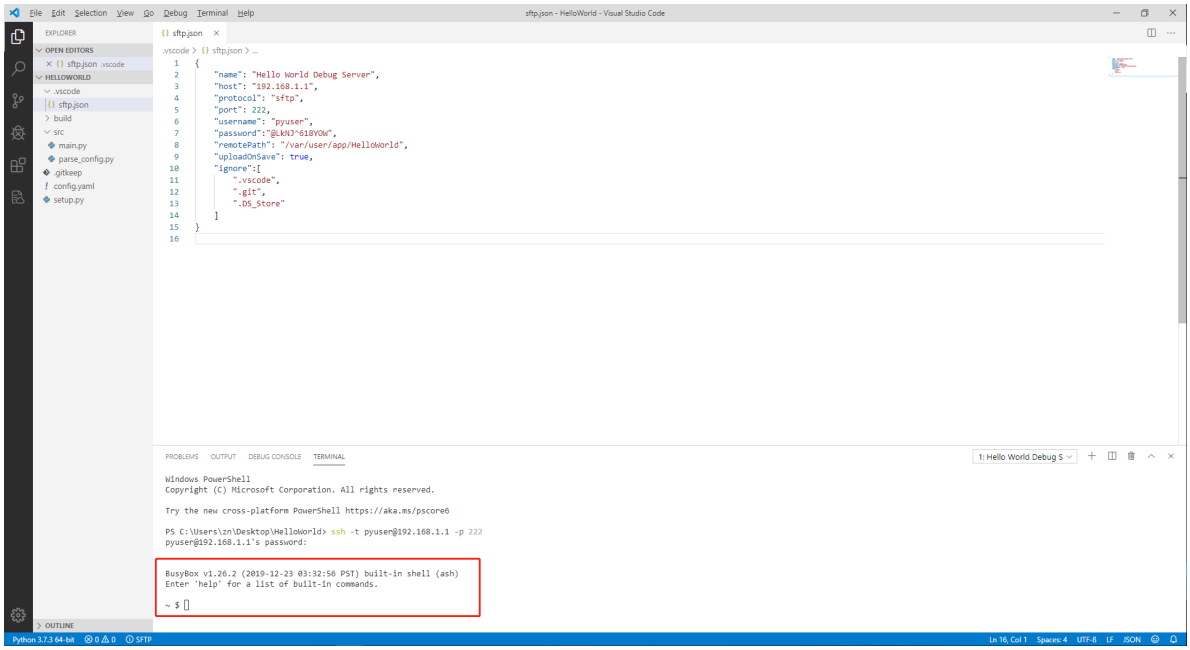
- Step 5: If this is the first time you connect to the server, the **TERMINAL** window prompts you to confirm whether you want to connect to the server. Enter **Yes** and press Enter. Then, enter the `>SFTP:Open SSH in Terminal` command and the IP address of the SFTP server in the Command Palette again.



- Step 6: The **TERMINAL** window prompts you to enter the password. You only need to copy the password in the `sftp.json` file, and paste it to the required place.



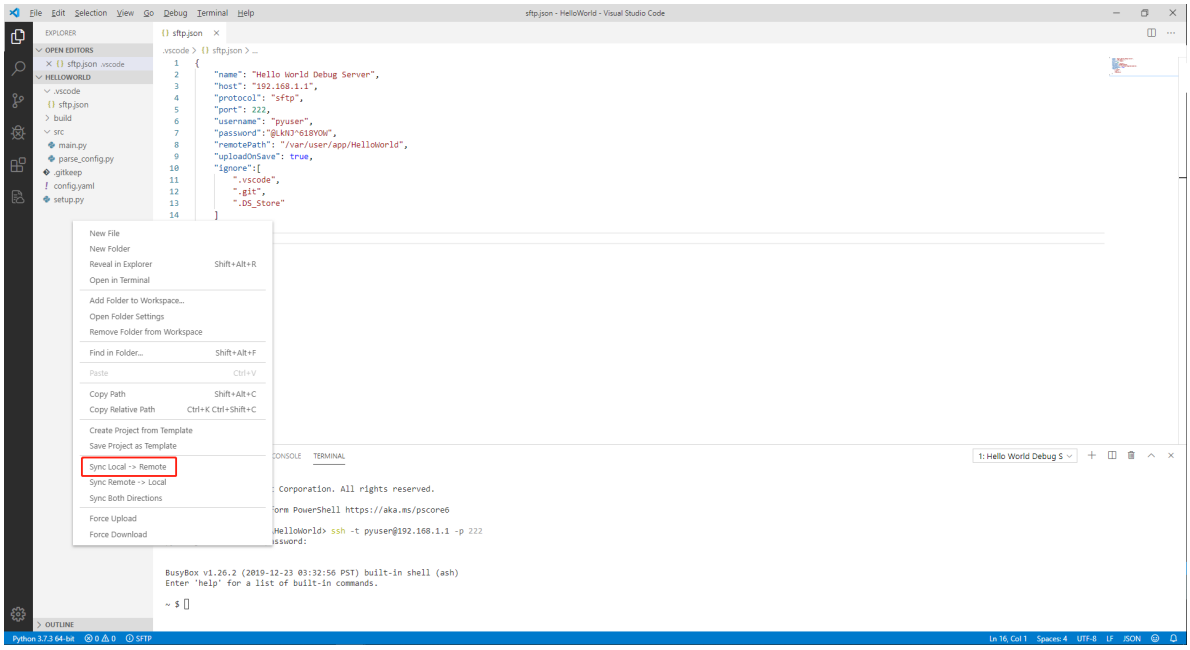
After an SFTP connection with MobiusPi is created, the page is shown as follows:



2.3.2 Debug the code

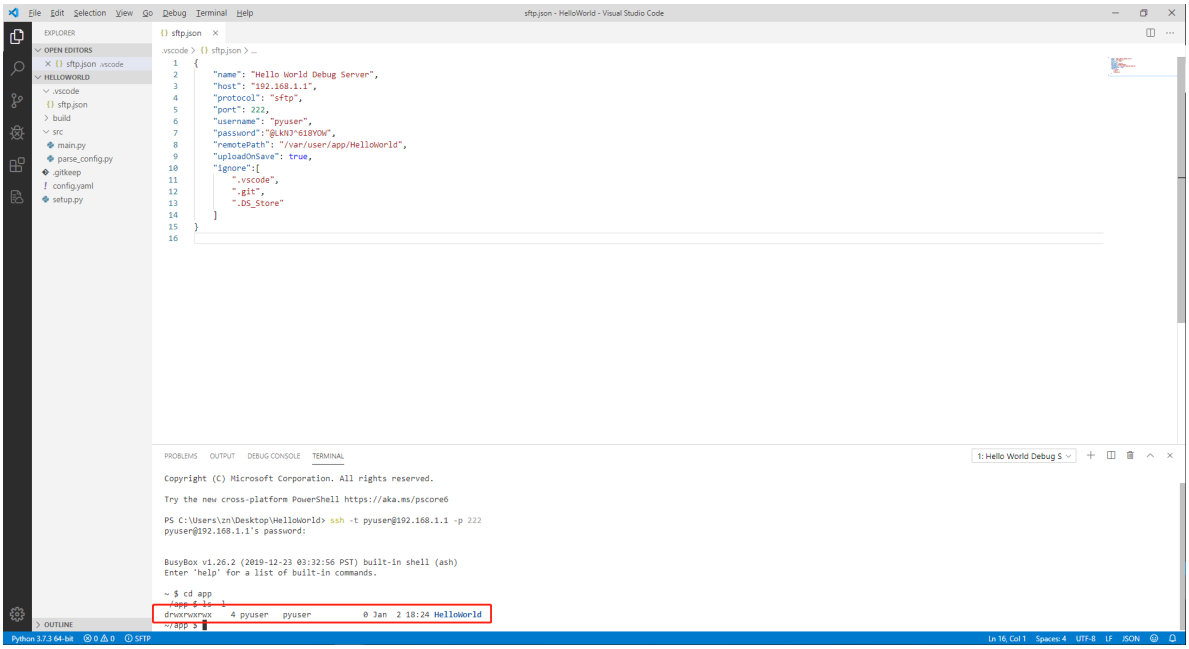
- Step 1: Synchronize the code.

  After the SFTP connection is created, right-click the blank area on the left, and choose **Sync Local > Remote** to synchronize the code to the remote server. Later, if you modify or delete code on the local PC, the code changes will be automatically synchronized to the remote server.



You can check whether the remote server has received the App code in the TERMINAL window. In the TERMINAL window, enter the following command to view uploaded App folder information:

```
cd app
ls -l
```



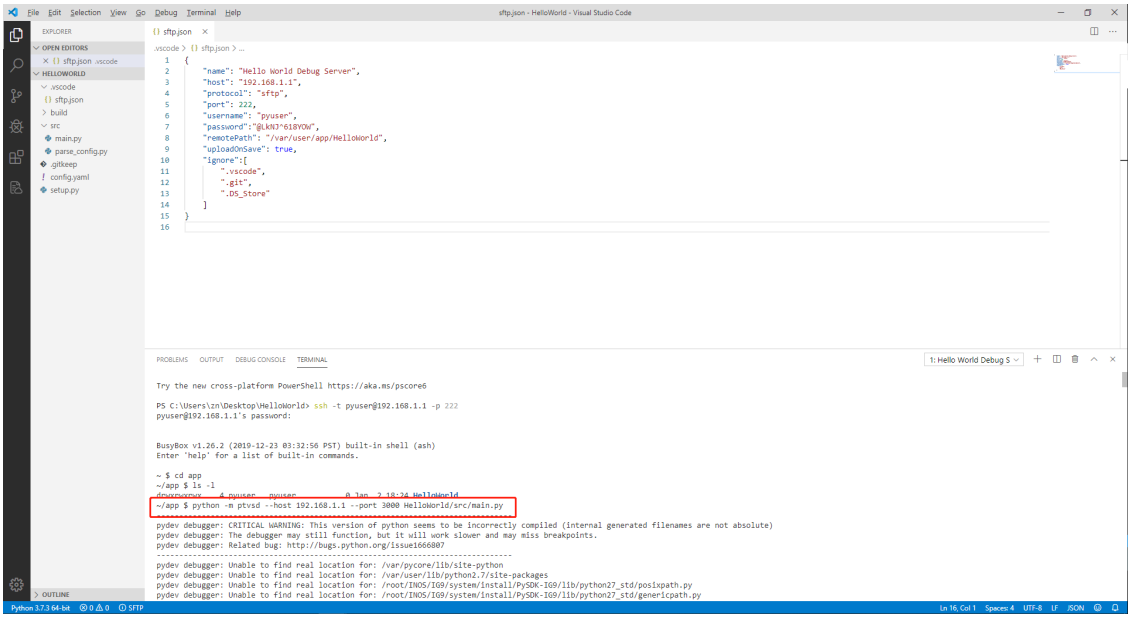
- Step 2: Debug the script in the TERMINAL window.
  - Method 1: Use ptvsd to debug the script

    After the code is synchronized, in the TERMINAL window, enter the following command to execute the script on MobiusPi immediately (take IG501 as an example). After the script is executed, you can view the execution result in the TERMINAL window: the log "hello world!" is printed. Note: MobiusPi' s Python development environment does not provide ptvsd dependent libraries by default, you can refer to *2.8.2 Install the third-party dependency library to SDK* to install it yourself

    ```
    python -m ptvsd --host 192.168.1.1 --port 3000 HelloWorld/src/main.py
    ```

    * `192.168.1.1` is the IP address of the **host** configured in `sftp.json`.
    * `3000` is the recommended debugging port number.
    * `HelloWorld/src/main.py` is the execution path of `mian.py`, which can be adjusted as needed.

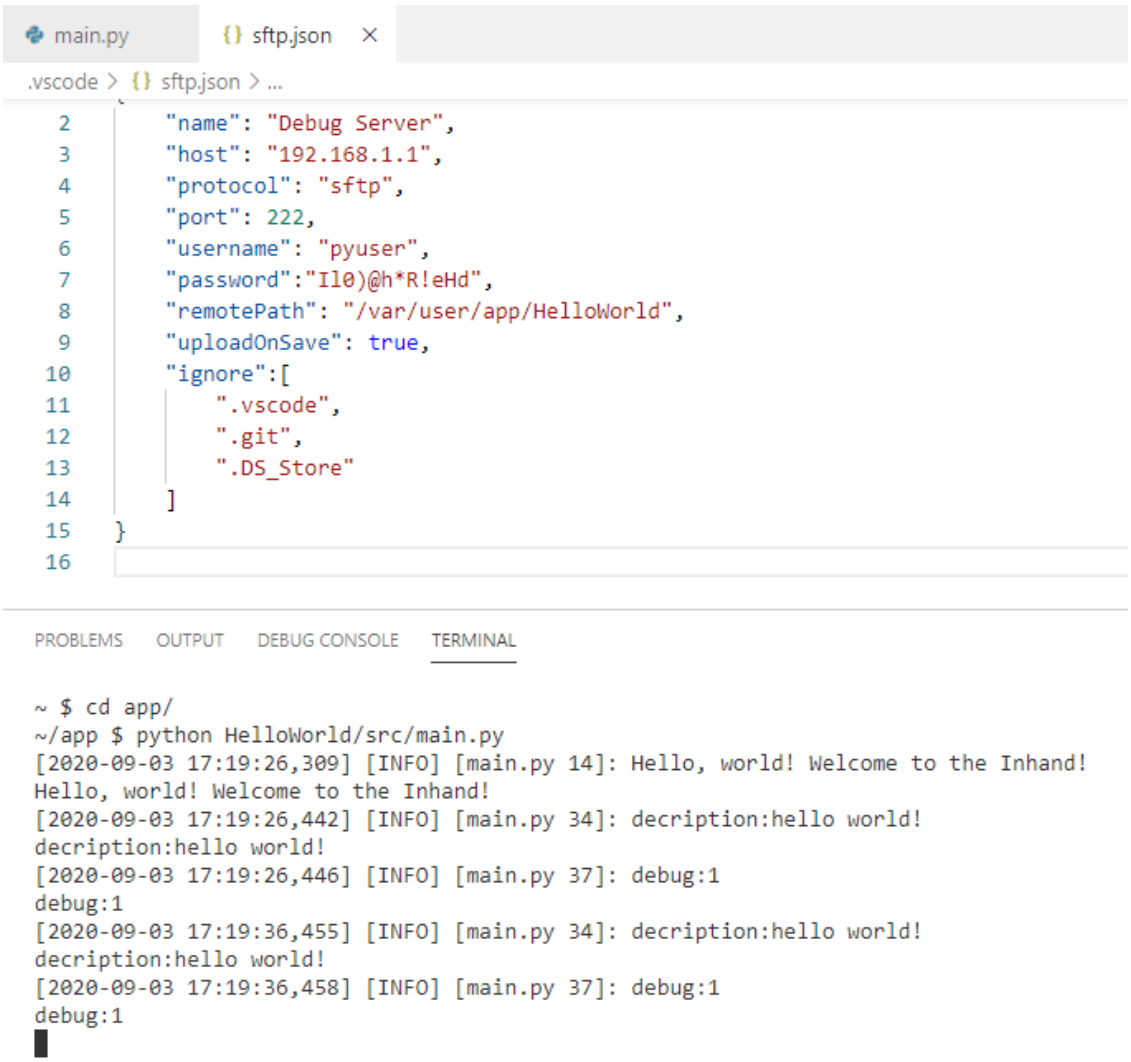
    For more information about the ptvsd plug-in, see ptvsd user manual.



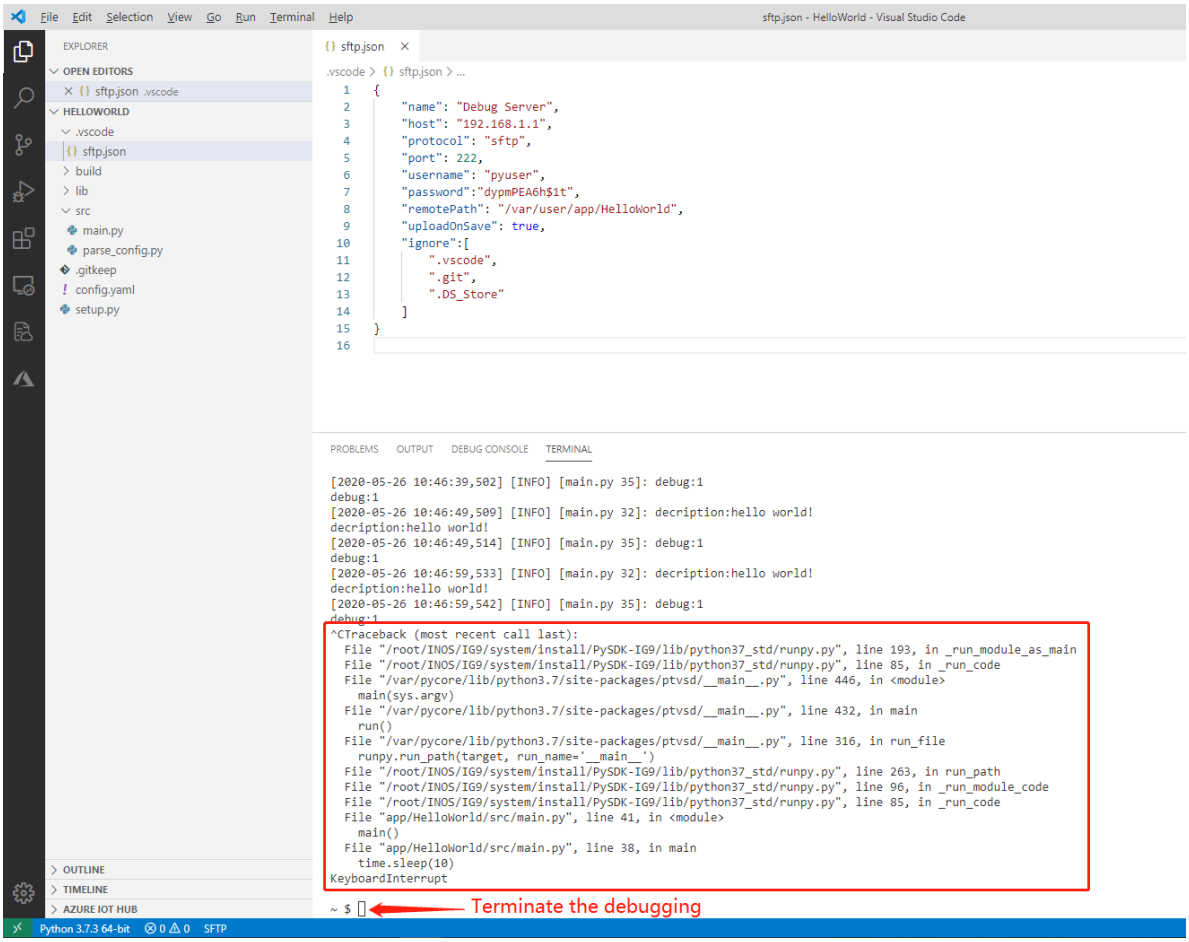
– Method 2: Run the script directly

After the code is synchronized, in the TERMINAL window, enter the following command to execute the script on IG501 immediately. After the script is executed, you can view the execution result in the TERMINAL window: the log "hello world!" is printed. (`HelloWorld/src/main.py` is the execution path of `mian.py`, which can be adjusted as needed.)

```
python HelloWorld/src/main.py
```



- Step 3: After debugging, press `Ctrl + C` on the terminal to terminate the debugging process.

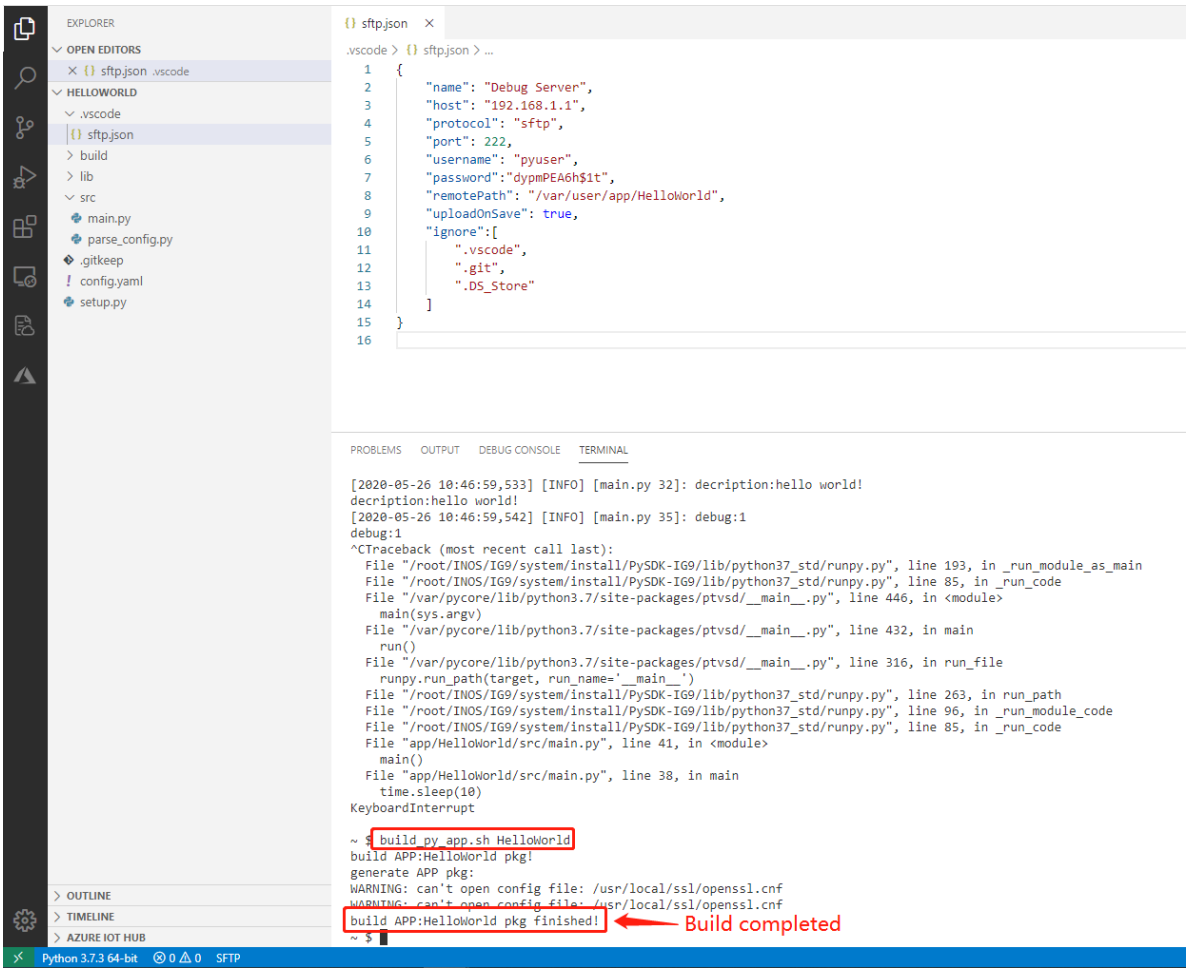


2.4 Build an App release package

After debugging, you can build an App release package to quickly deploy the App to other MobiusPi devices.

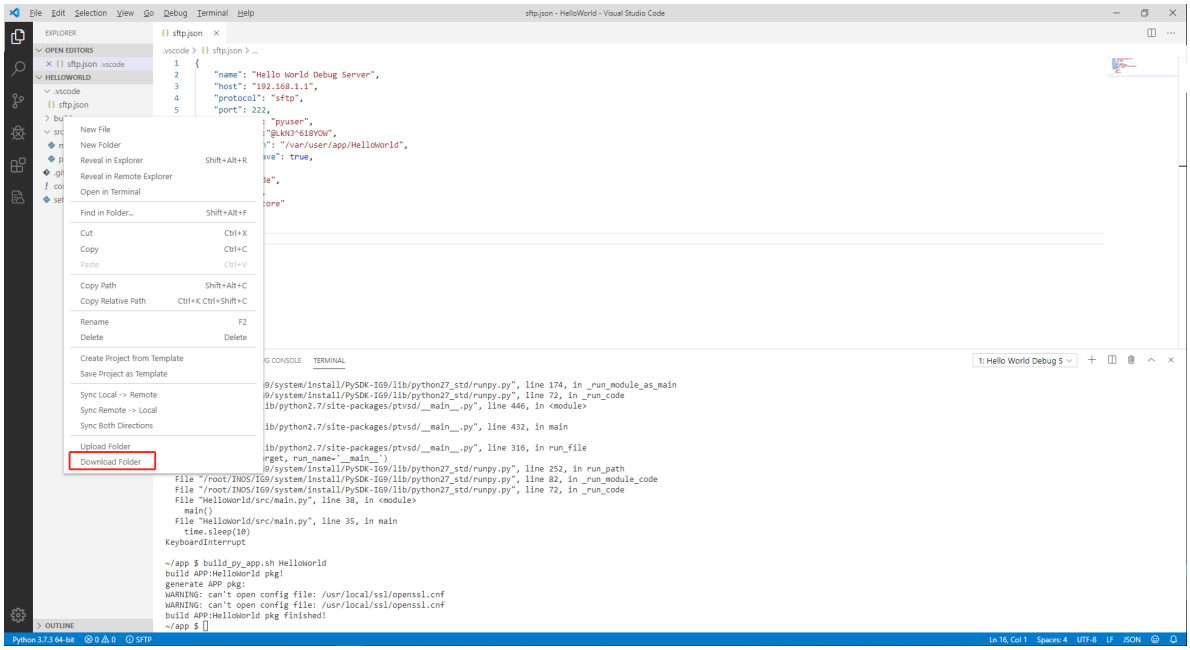
- Step 1: Build an App release package.

  In the **TERMINAL** window, run the `build_py_app.sh HelloWorld` command to build an App release package. (That is, the `build_py_app.sh` Python App name.)

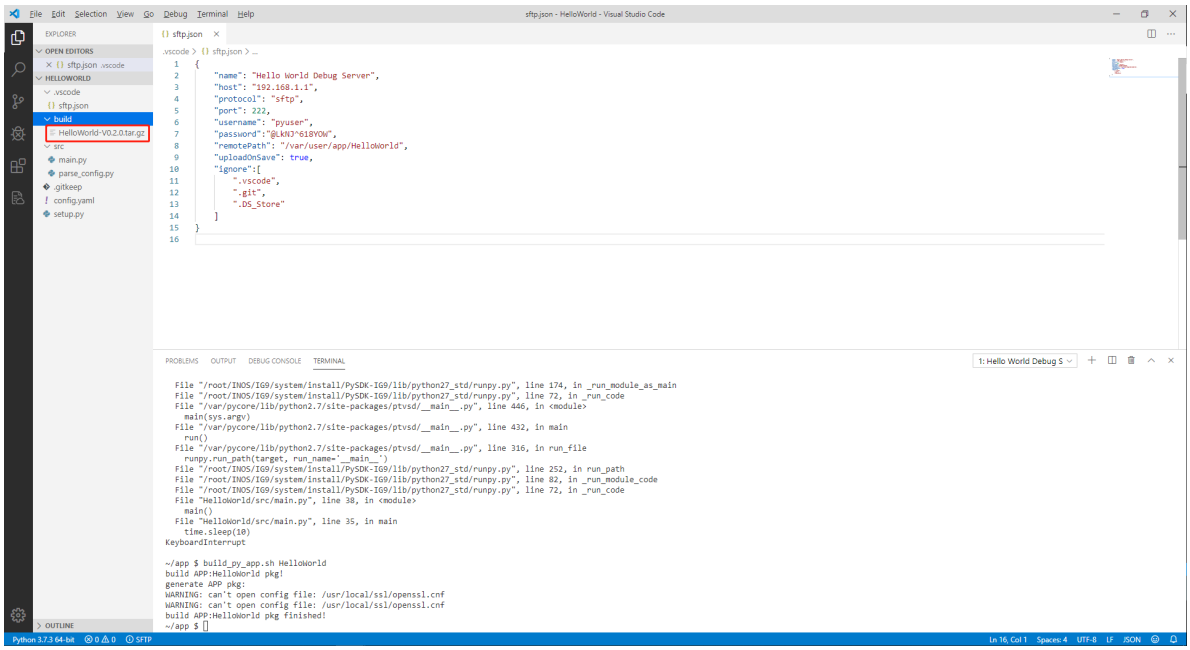


- Step 2: Download the App release package.

  After the command is executed, the App release package is automatically generated in the build directory on the remote server. Right-click the **build** folder and select **Download Folder** to download the built App release package to the local PC for subsequent deployment.



After the package is downloaded, you can view the HelloWorld App release package in the build directory.



2.5 Deploy the App on the MobiusPi web page

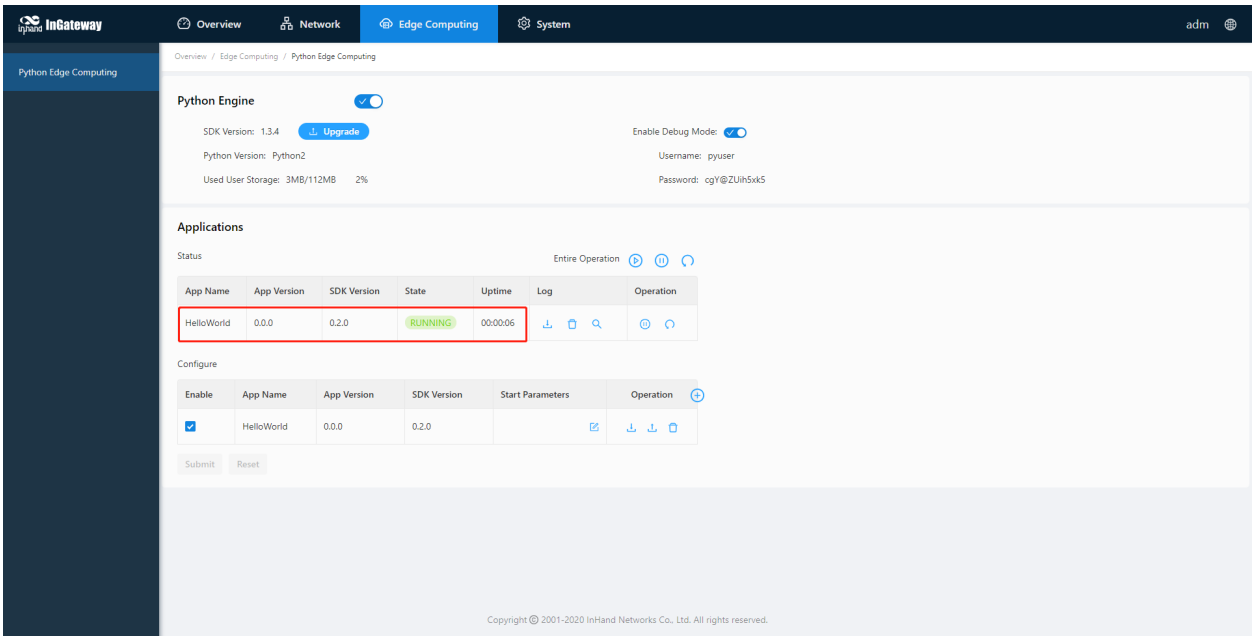
Run the `main.py` script. Or, after the App release package is built, the App is automatically generated on the connected MobiusPi, but this App cannot be started. Refer to the following links to deploy the App to MobiusPi:

- Deploy an App on IG501

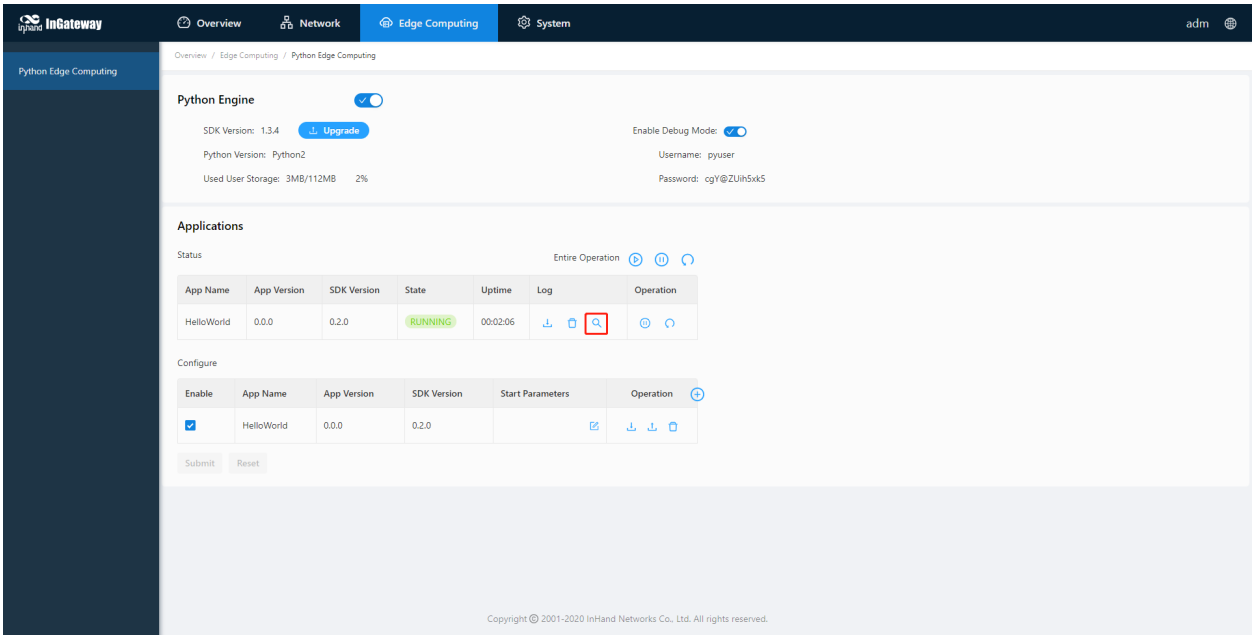
- Deploy an App on IG502
- Deploy an App on IG902

2.6 View the App running status

You can view the App running status on the **Edge Computing > Python Edge Computing** page in MobiusPi.



Click **View Logs** to view the App running logs.



```
DEBUG:root:Hello, world! Welcome to the Inhand!
INFO:root:decription:hello world!
INFO:root:debug:1
INFO:root:decription:hello world!
INFO:root:debug:1
INFO:root:decription:hello world!
INFO:root:debug:1
INFO:root:decription:hello world!
INFO:root:debug:1
INFO:root:decription:hello world!
INFO:root:debug:1
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INFO:root:debug:1
INFO:root:decription:hello world!
INFO:root:debug:1
INFO:root:decription:hello world!
INFO:root:debug:1
INFO:root:decription:hello world!
INFO:root:debug:1
```
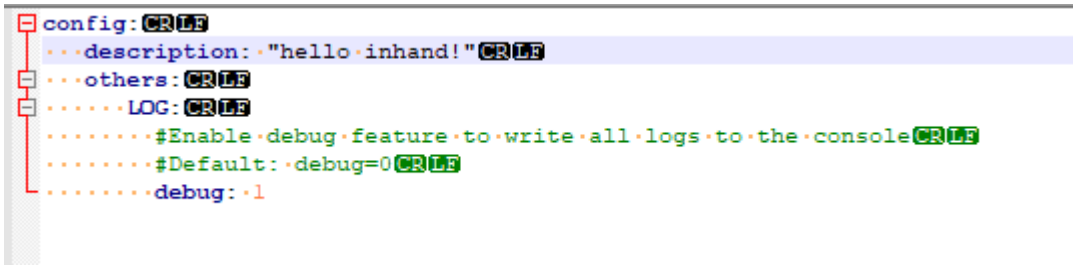

2.7 Update the App configuration file

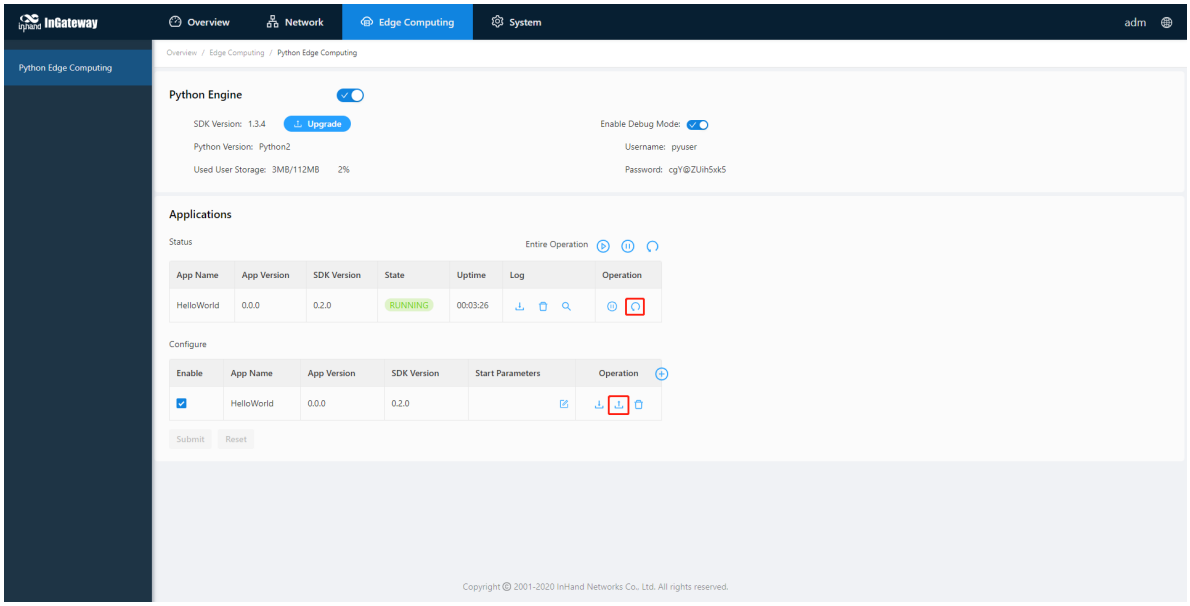
- Step 1: Modify the configuration file.

  In the **config.yaml** file of the App, modify `description: "hello world!"` to `description: "hello inhand!"`.



- Step 2: Import the configuration file and restart the App.

  On the **Edge Computing > Python Edge Computing** page in MobiusPi, import the modified configuration file of the **HelloWorld** App, and restart the App.



After restart, the HelloWorld App runs with the updated configuration file and prints a log "hello inhand!" every 10s.

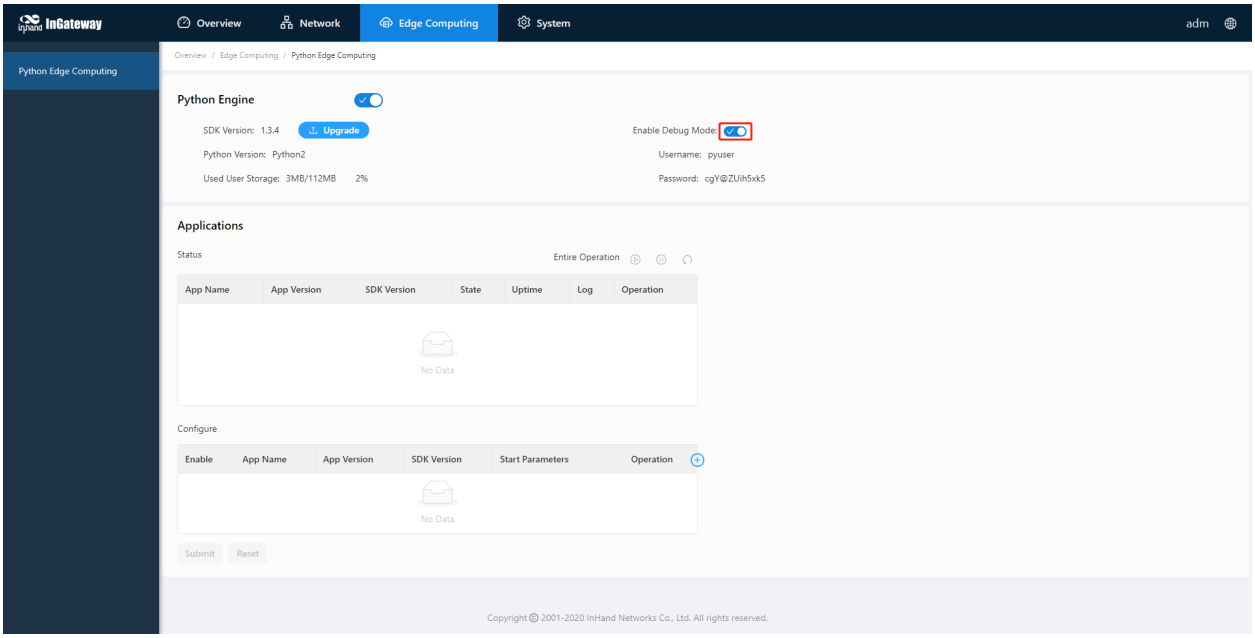
```
DEBUG:root:Hello, world! Welcome to the Inhand!
INFO:root:decription:hello world!
INFO:root:debug:1
INFO:root:decription:hello world!
INFO:root:debug:1
INFO:root:decription:hello world!
INFO:root:debug:1
INFO:root:decription:hello world!
DEBUG:root:Hello, world! Welcome to the Inhand!
INFO:root:decription:hello inhand!
INFO:root:debug:1
INFO:root:decription:hello inhand!
INFO:root:debug:1
INFO:root:decription:hello inhand!
INFO:root:debug:1
INFO:root:decription:hello inhand!
INFO:root:debug:1
INFO:root:decription:hello inhand!
```

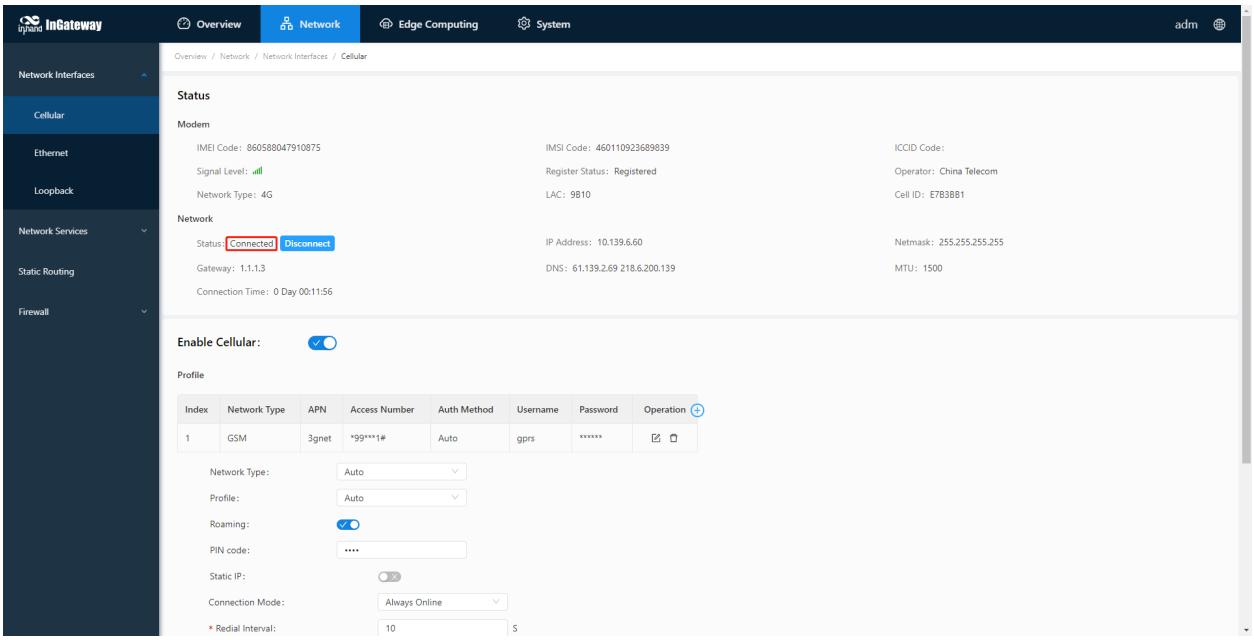
2.8 Annex

- *2.8.1 Install a third-party dependency library for the specified App*
- *2.8.2 Install the third-party dependency library to SDK*
- *2.8.3 Enable automatic code completion*

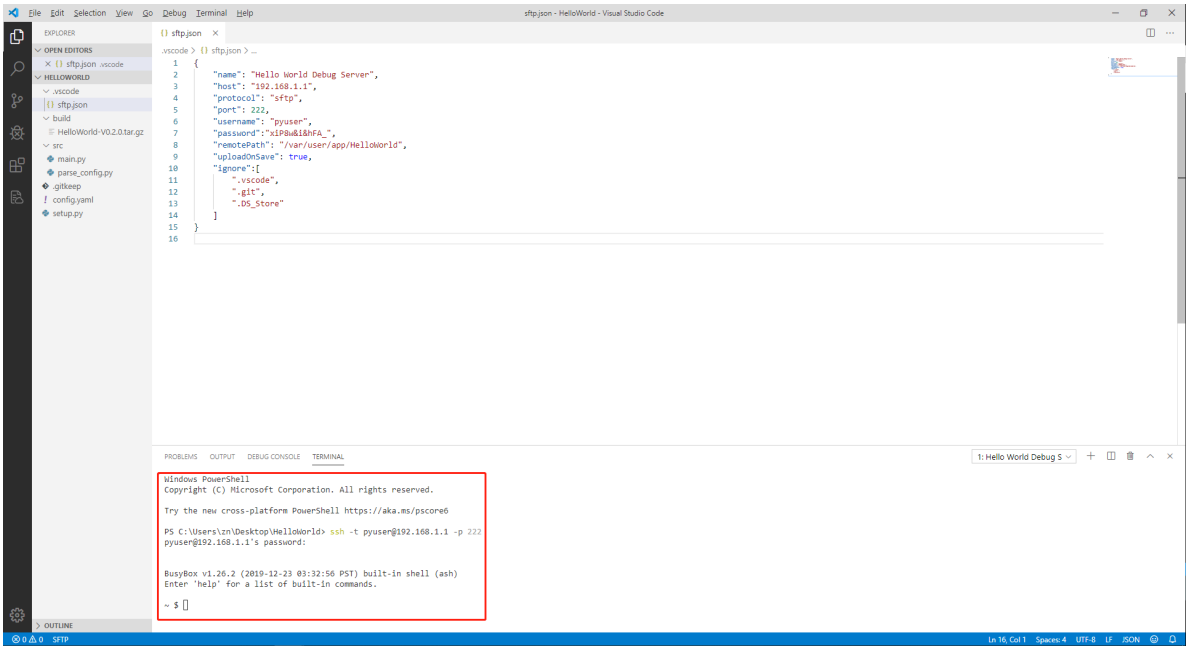
2.8.1 Install a third-party dependency library for the specified App

To install a third-party dependency library for the specified App, you need to enable the debugging mode for MobiusPi and connect to the Internet. The following takes installing the `xlrd` dependency library to the HelloWorld App as an example to describe how to install a third-party dependency library to a specified App.



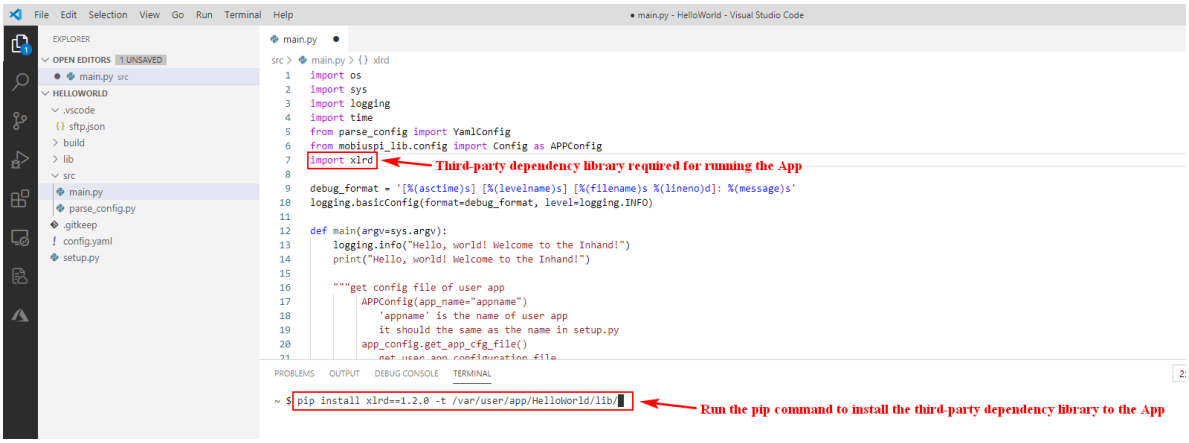


- Step 1: Use VS Code to connect to MobiusPi over SFTP. For more information, see *Create an SFTP connection*.

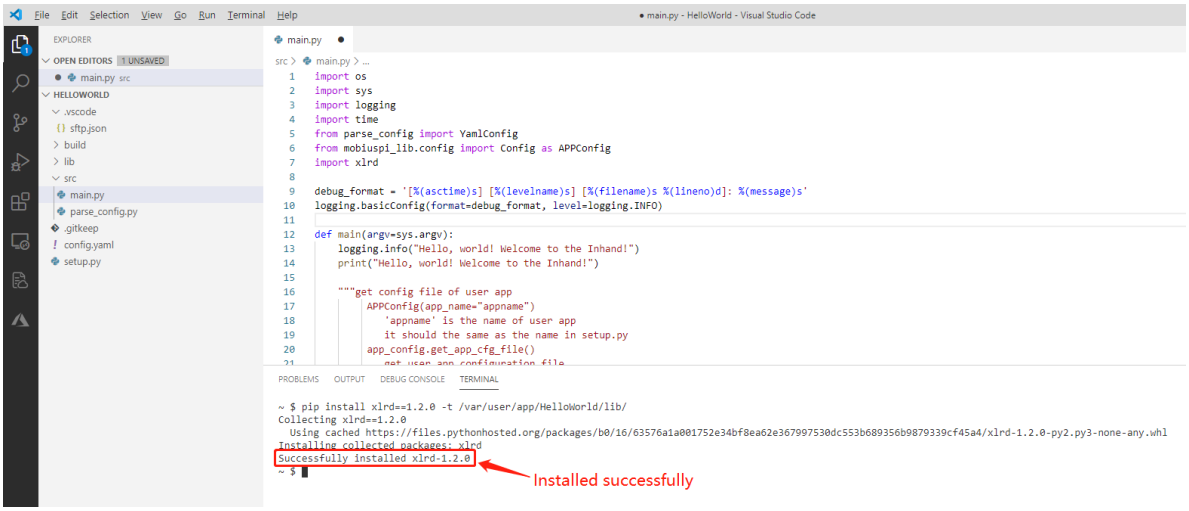


- Step 2: Run `pip install` + **dependency library name** + **==version number** + `-t` + **App' s lib folder path** and press Enter to install the dependency library to the specified App. (If the version number is not added, after the pip command is run, the latest dependency library is automatically installed.)

```
pip install xlrd==1.2.0 -t /var/user/app/HelloWorld/lib/
```

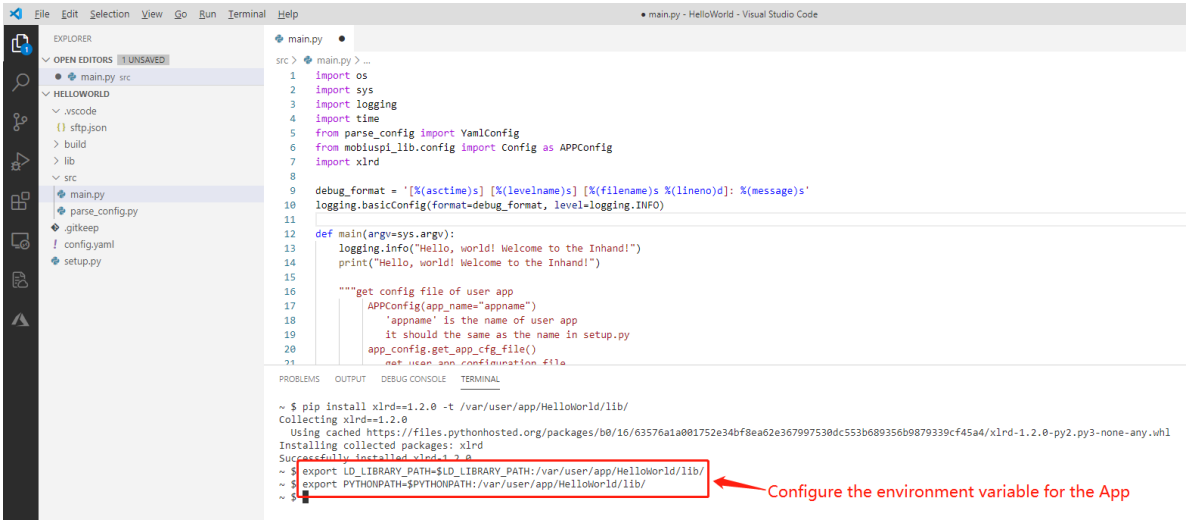


- Step 3: Then, the dependency library is automatically downloaded and installed. After the library is installed, the following figure is displayed:



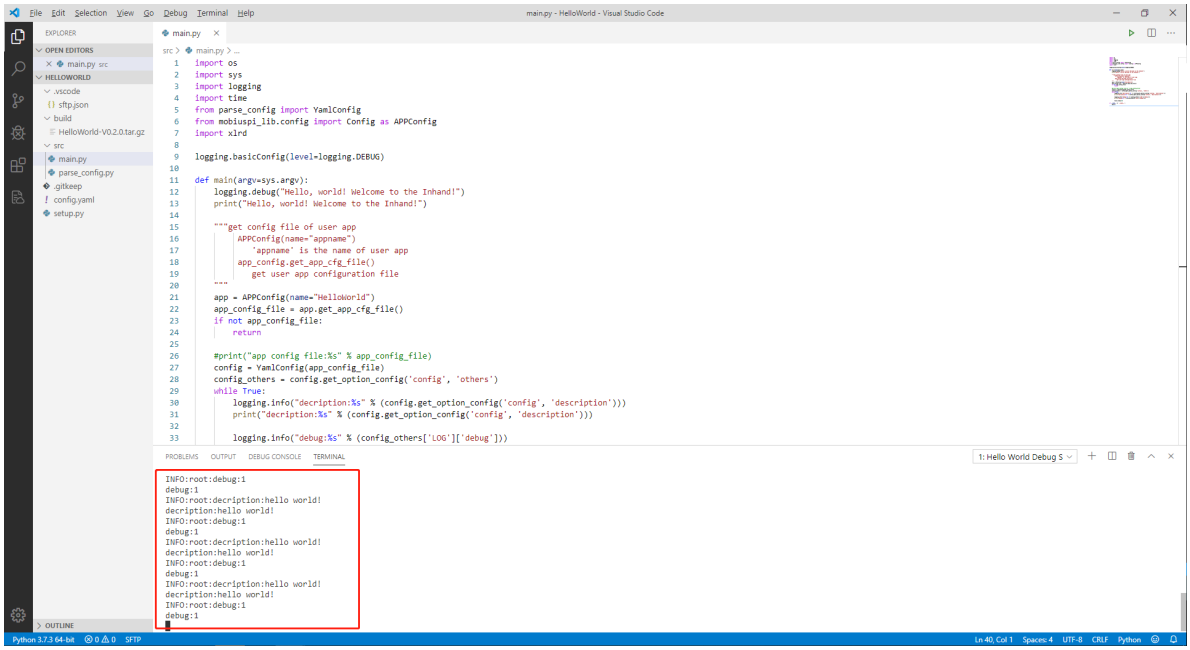
- Step 4: Run the `export` command to set an environment variable for the App. In the TERMINAL window, run the following command (replace **HelloWorld** with the actual App name).

```
export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:/var/user/app/HelloWorld/lib/
export PYTHONPATH=$PYTHONPATH:/var/user/app/HelloWorld/lib/
```



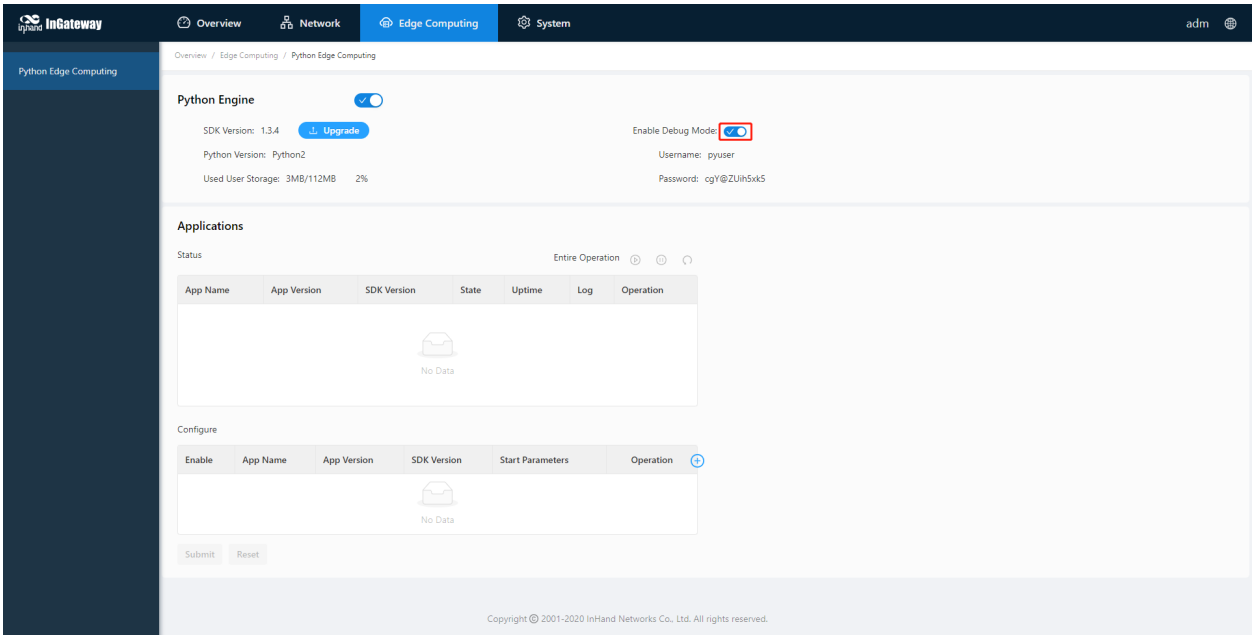
After the third-party dependency library is installed for the specified App, you must configure a corresponding environment variable before debugging this App; otherwise, this App cannot run during debugging. When multiple third-party dependency libraries are installed, you just need to add the environment variable once. After an SFTP connection is created again, you need to configure the environment variable again. When the App is started in MobiusPi, the environment variable of the third-party dependency library is automatically added to the App' s lib folder.(This method is mainly used for third-party dependent libraries where the App needs to install a special version)

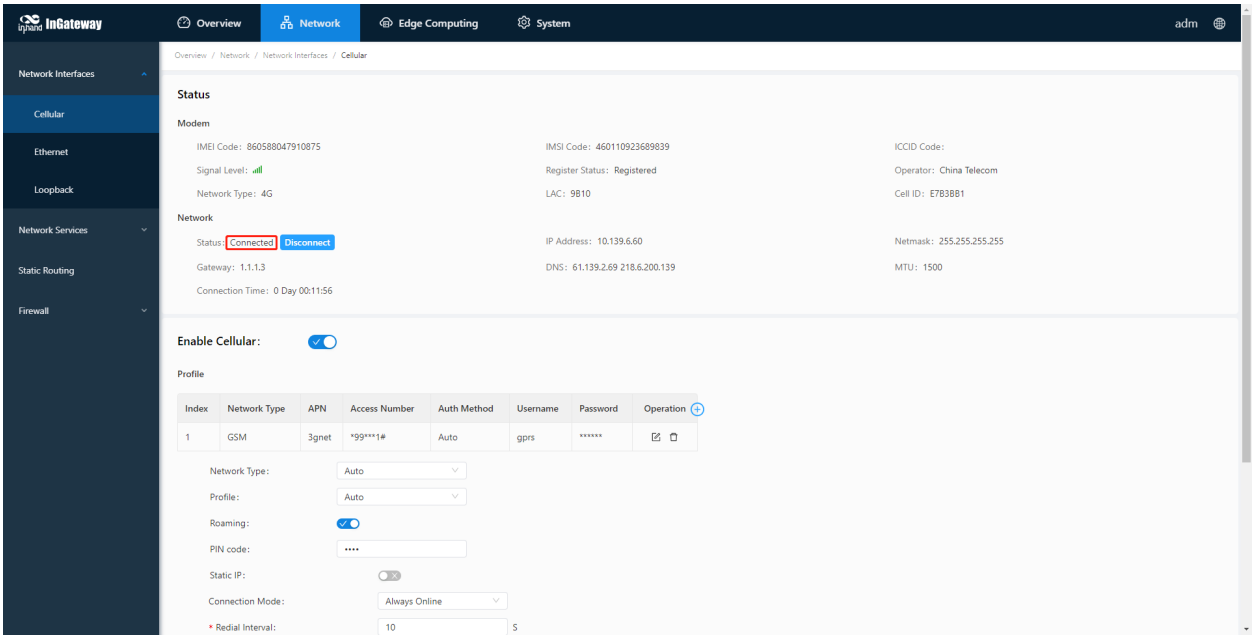
- Step 5: Run the code to check whether the App runs normally.



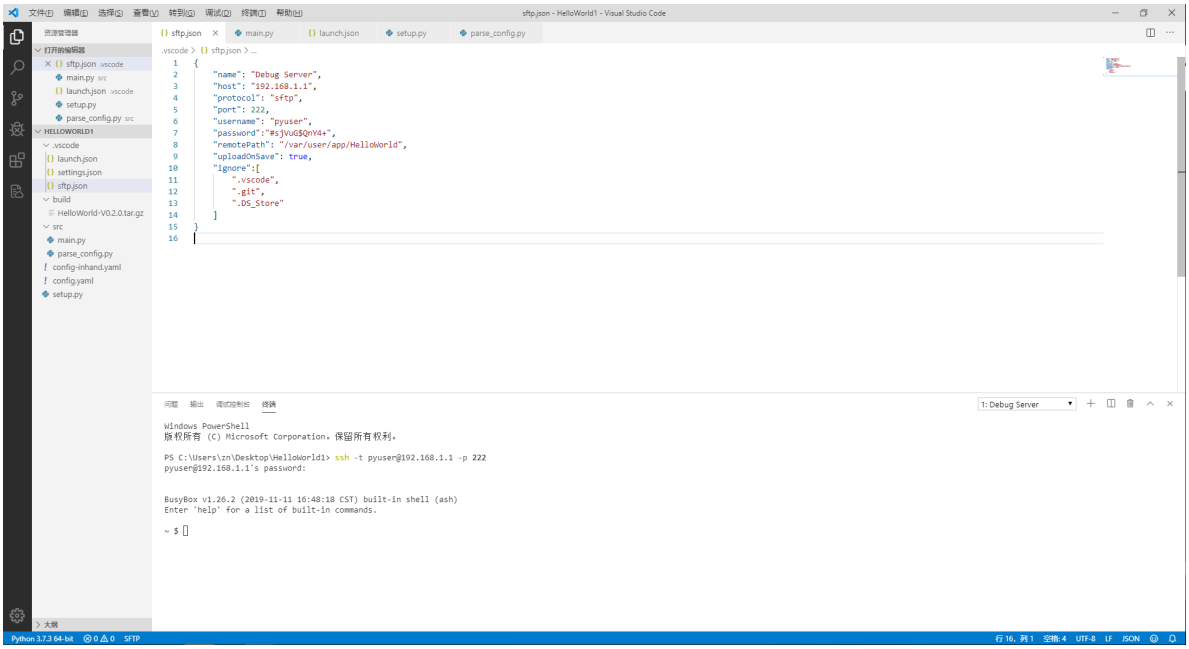
2.8.2 Install the third-party dependency library to SDK

To install a third-party dependency library to SDK, you need to enable the debugging mode for MobiusPi and connect to the Internet. The following takes installing the `xlrd` dependency library to SDK as an example to describe how to install a third-party dependency library to SDK.



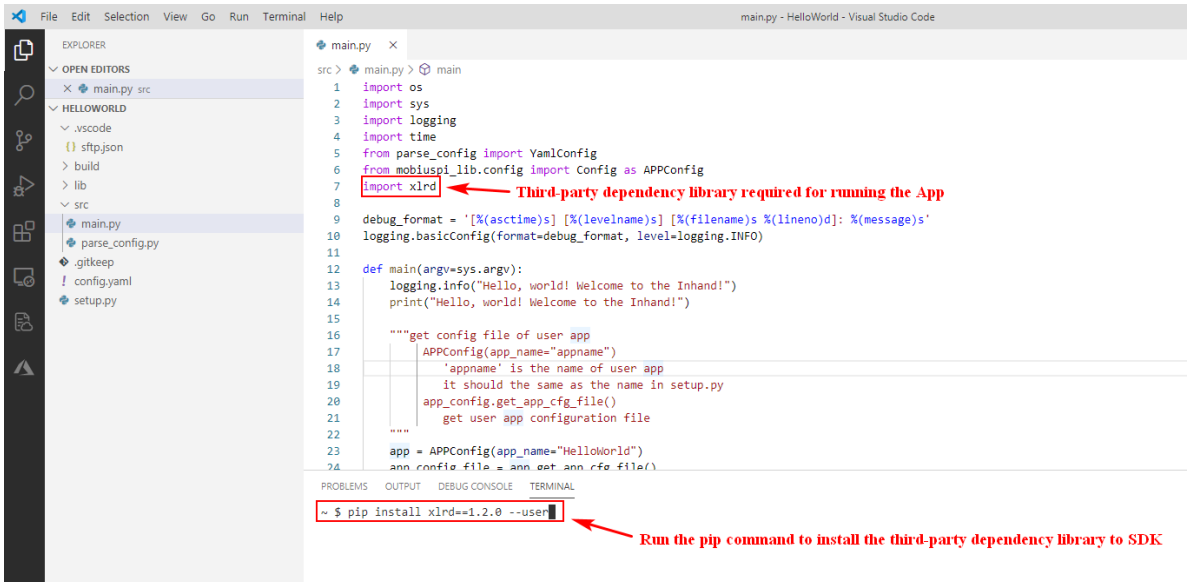


- Step 1: Use VS Code to connect to MobiusPi over SFTP. For more information, see *Create an SFTP connection*.

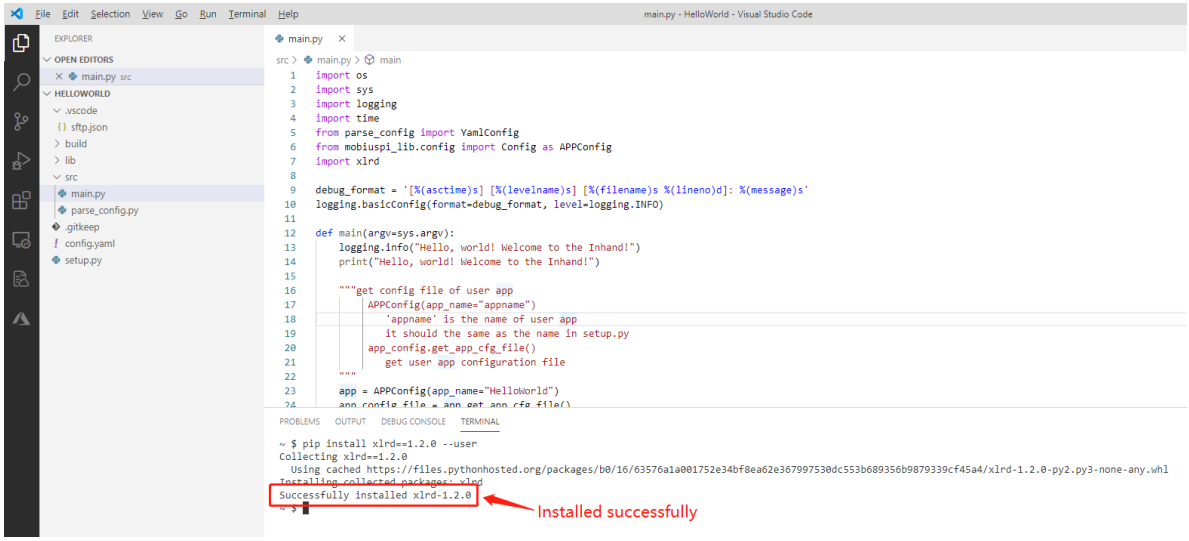


- Step 2: Run `pip install` + **dependency library name** + **==version number** + `--user` and press Enter to install the dependency library to SDK. (If the version number is not added, after the pip command is run, the latest dependency library is automatically installed.)

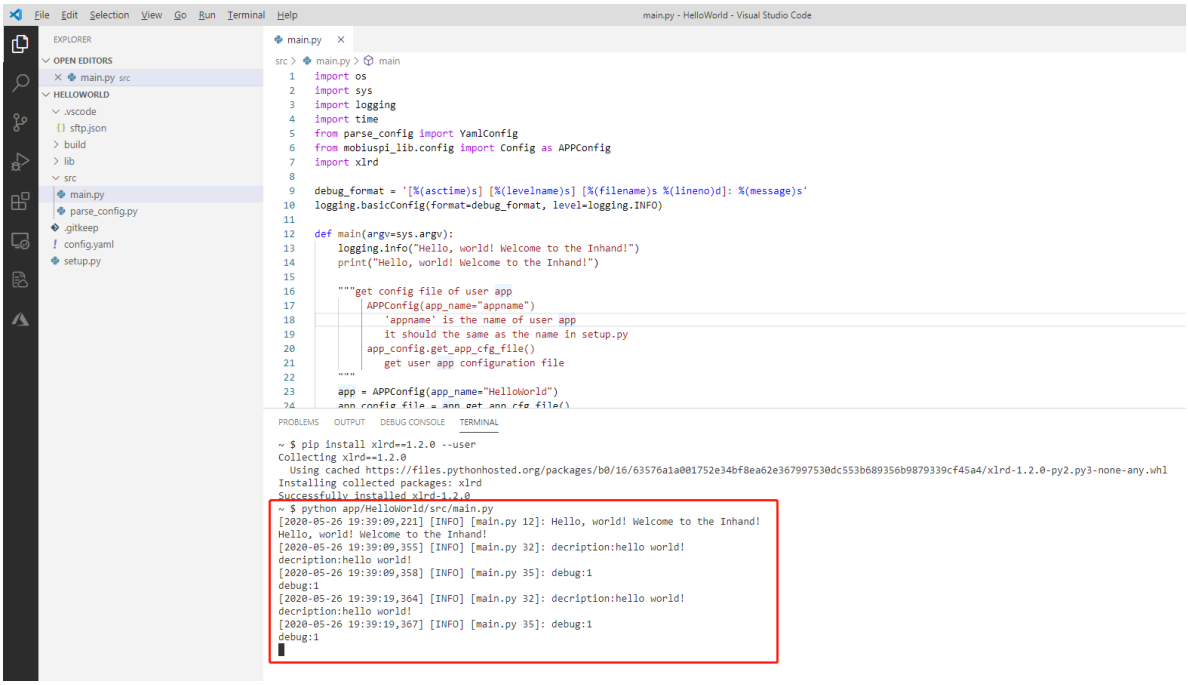
```
pip install xlrd==1.2.0 --user
```



- Step 3: Then, the dependency library is automatically downloaded and installed. After the library is installed, the following figure is displayed:



- Step 4: Run the code to check whether the App runs normally.

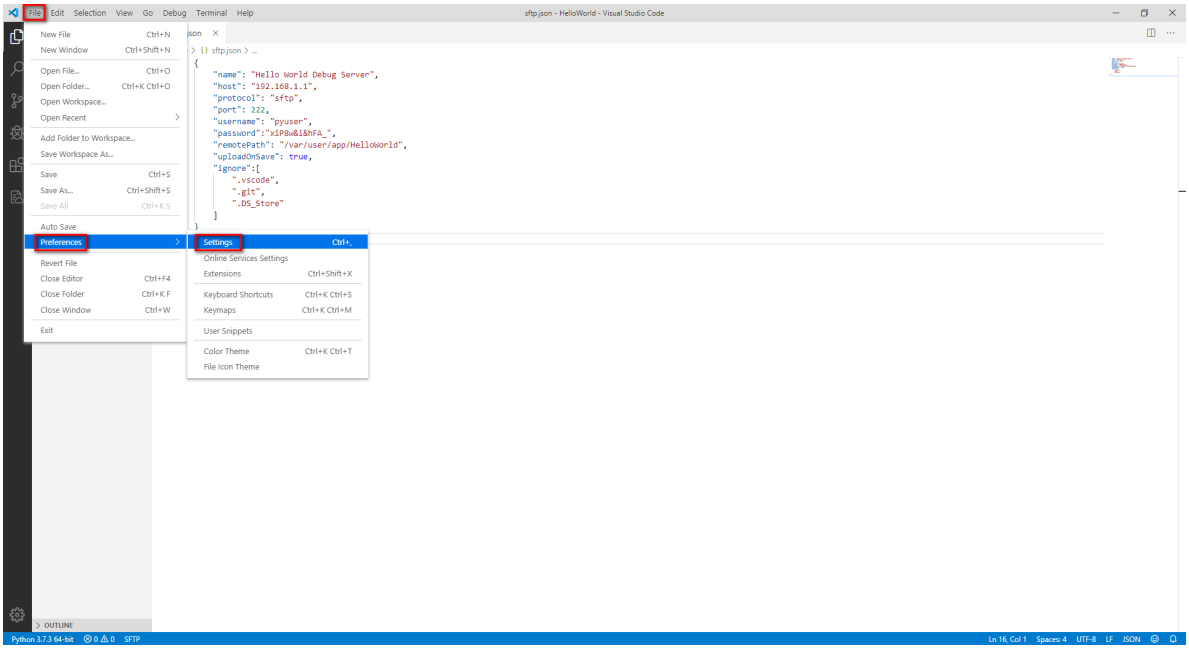


Note: When using this method to install a third-party dependency library, the packaged App release package will be automatically installed into the MobiusPi when it is deployed on other MobiusPi.

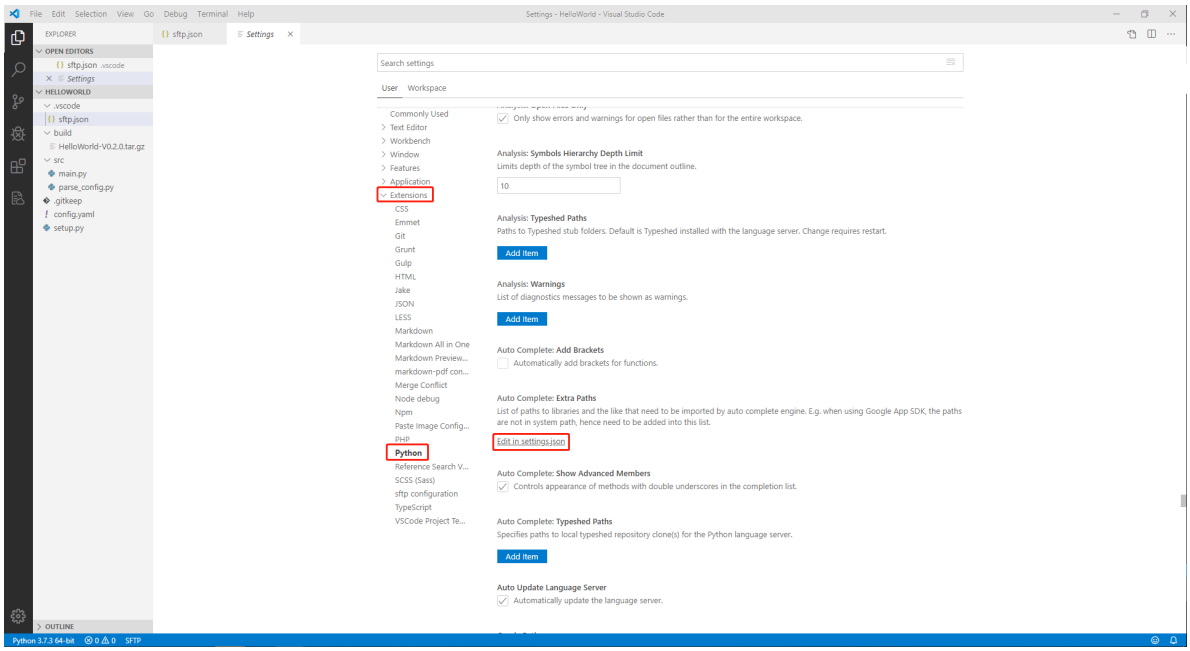
2.8.3 Enable automatic code completion

To improve the encoding efficiency, you can implement automatic code completion by using Python extensions.

- Step 1: Choose **Files > Preferences > Settings** to enter the Settings page.

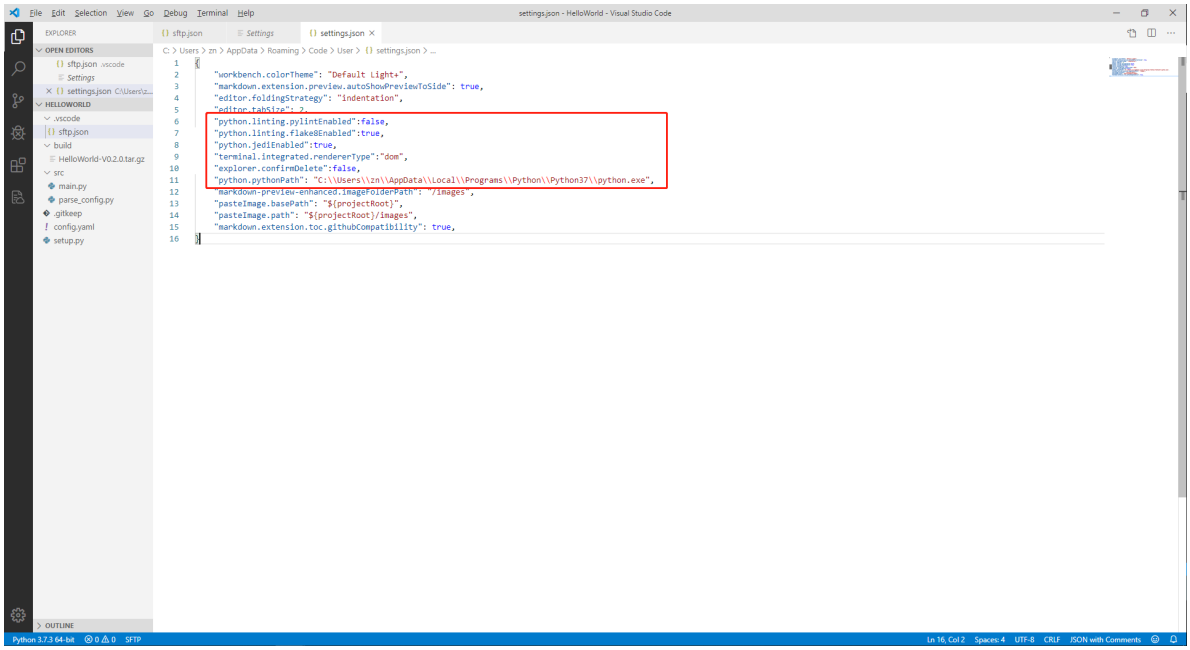


- Step 2: On the Settings page, choose **Extensions > Python**, locate **Auto Complete: Extra Paths**, and then click **Edit in setting.json**.



Add the following configuration items to **settings.json** and save the configuration (`python.pythonPath` is the installation path of the Python interpreter).

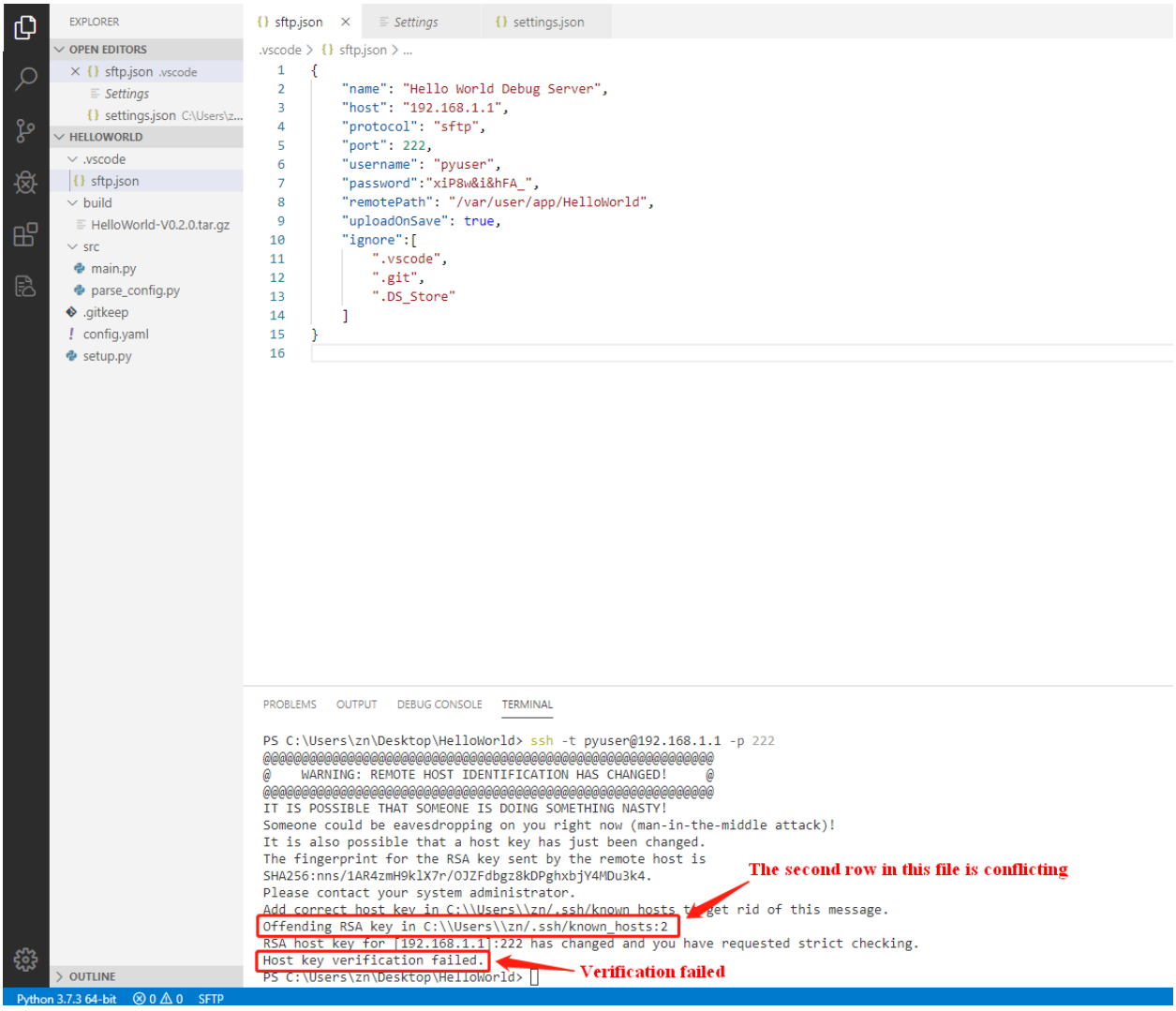
```
"python.linting.pylintEnabled":false,
"python.linting.flake8Enabled":true,
"python.jediEnabled":true,
"terminal.integrated.rendererType":"dom",
"explorer.confirmDelete":false,
"python.pythonPath":"C:/Users/zn/AppData/Local/Programs/Python/Python37",
```



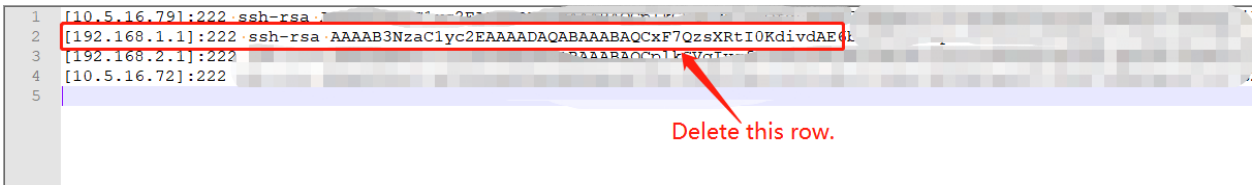
1.1.3 FAQ

- *During SFTP connection building, it prompts "REMOTE HOST IDENTIFICATION HAS CHANGED and Host key verification failed"*
- *When synchronizing the code to the remote server, it prompts "All configured authentication methods failed"*
- *How to call the serial port and network port of MobiusPi*
- *When creating an SFTP connection with MobiusPi, it prompts "SSH error"*

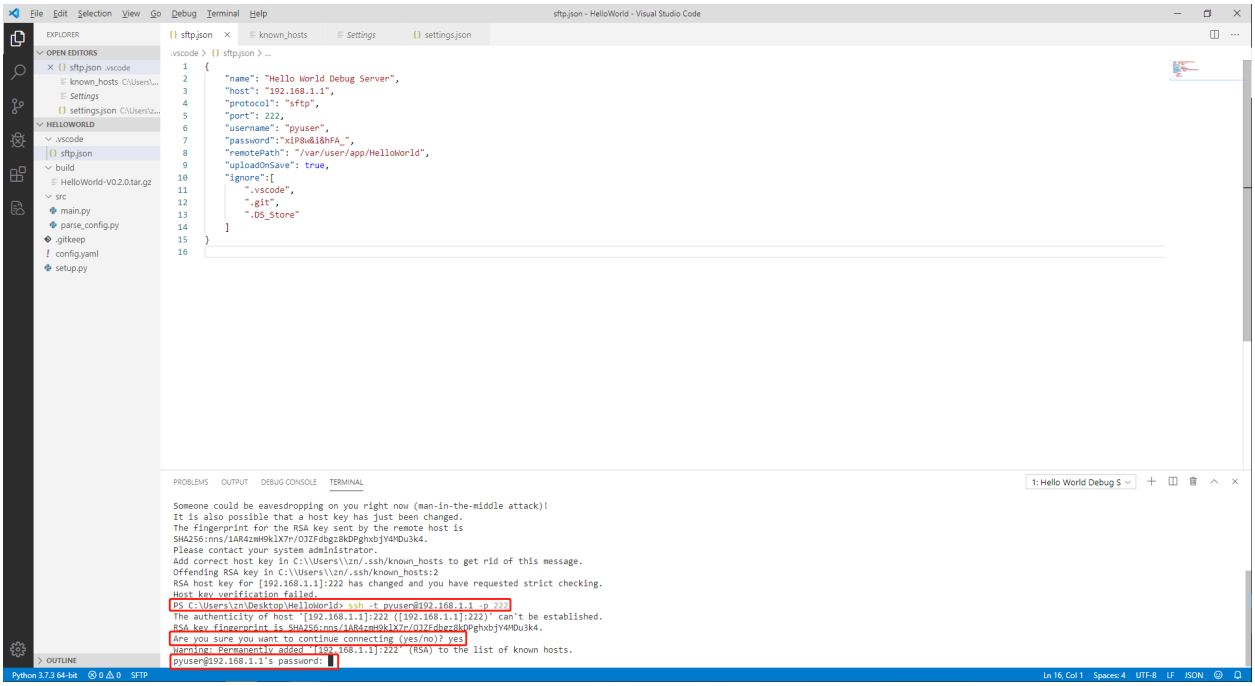
Q1: During SFTP connection building, it prompts "REMOTE HOST IDENTIFICATION HAS CHANGED and Host key verification failed" . What should I do?



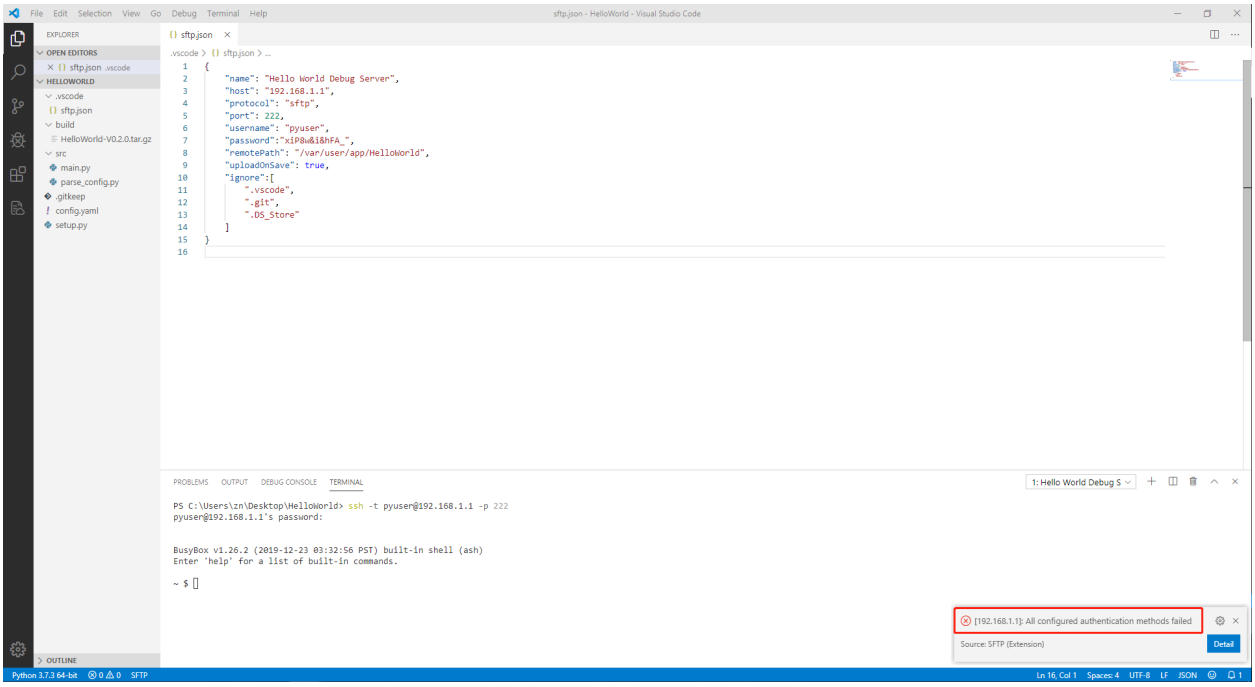
A1: The reason is that the MobiusPi key has been updated but the PC key does not, resulting in authentication failure. To solve the problem, just delete the row with key conflict from the key file. Press Ctrl and click the conflicting item to quickly access the link.



After deletion, run the `>SFTP:Open SSH in Terminal` command. Then, an SFTP connection is created.



Q2: After the SFTP connection is created, right-click on a blank area and choose Sync Local > Remote to synchronize the code to the remote server. It prompts "All configured authentication methods failed" . What should I do?

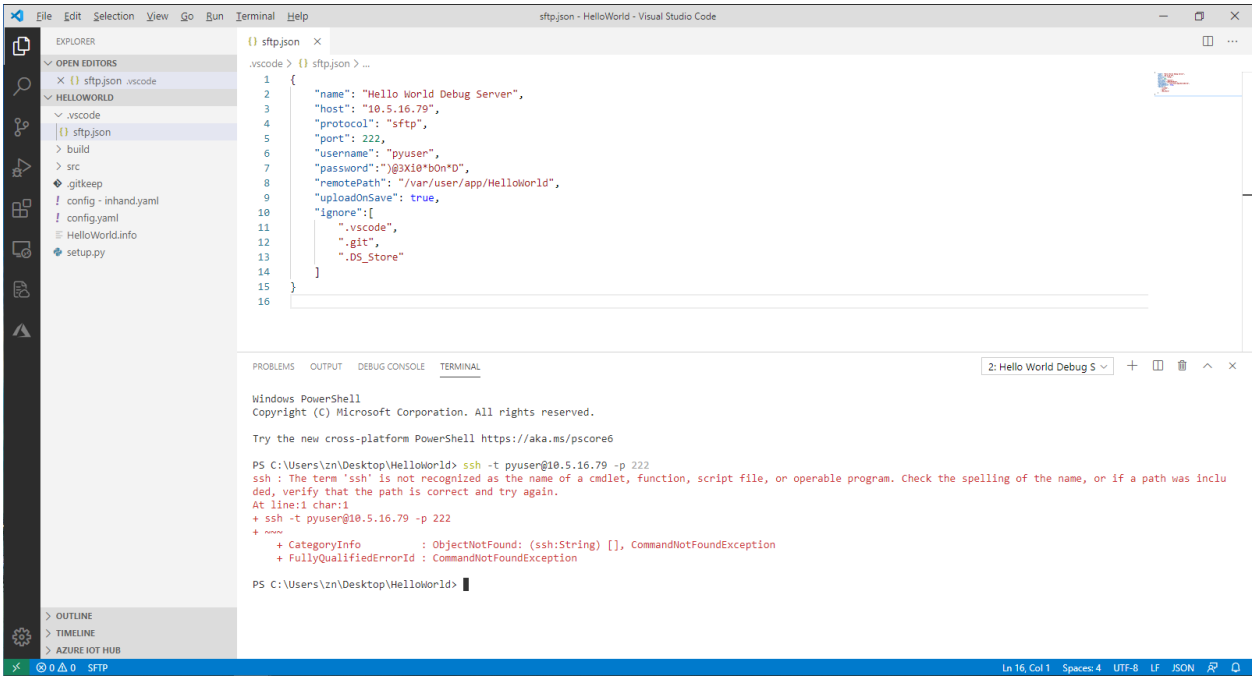


A2: Ensure that the password in the **sftp.json** file is same to that on MobiusPi. After the passwords are the same, synchronize the code again.

Q3: How to call the serial port and network port of MobiusPi?

A3: The RS485 serial port name of IG902 is `/dev/ttyO3` and the RS232 serial port name is `/dev/ttyO1`; The RS485 serial port name of IG502 is `/dev/ttyO3` and the RS232 serial port name is `/dev/ttyO1`; The RS485 serial port name of IG501 is `/dev/ttyO1` and the RS232 serial port name is `/dev/ttyO5`. The serial port and network port can be called with the standard Python serial port/network port usage. For example, use the `pyserial` library to call the serial port.

Q4: When creating an SFTP connection with MobiusPi, it prompts "SSH error" , as shown in the following figure. What should I do?



A4: Install OpenSSH to support the SSH protocol. Download OpenSSH from https://www.openssh.com.

1.2 MobiusPi API Manual

- *MobiusPi API Manual*
  - *Overview*
  - *Installation SDK*
  - *Python requirements*
  - *1. Basic*
    - *Getting started*
    - *Instructions for use*

- *Returns*
- *Exception*

1.2.1 Overview

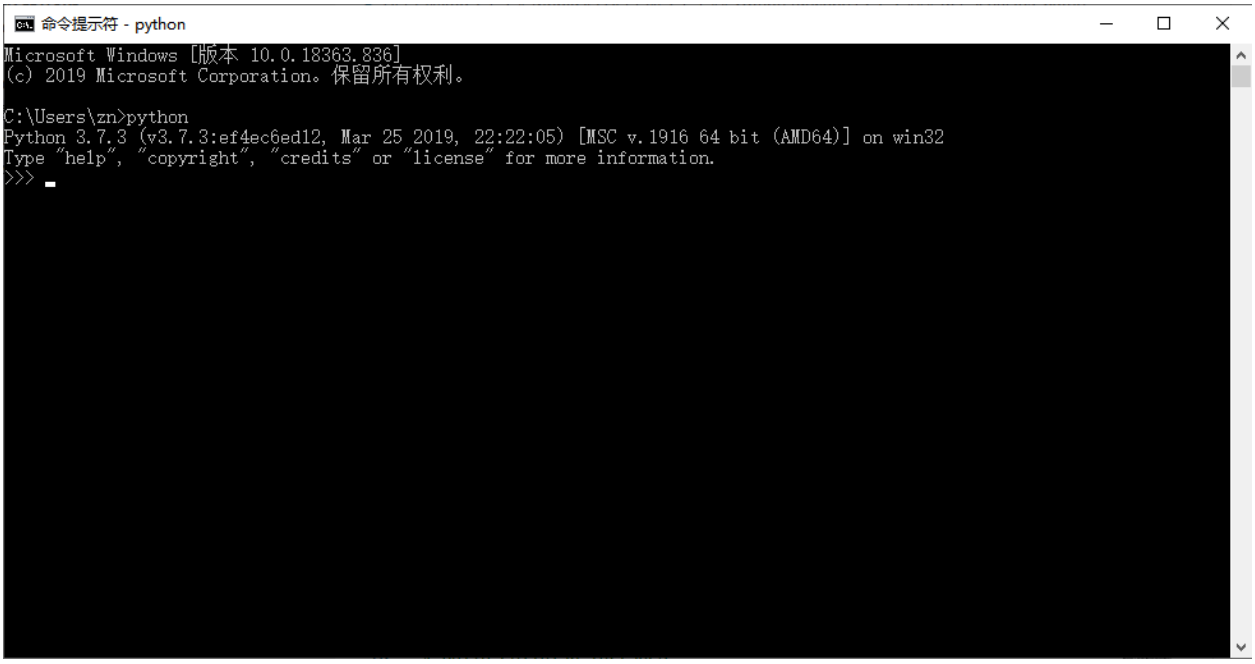
MobiusPi is the secondary development platform for the InGateway series product. This document explains how to call the APIs of the `mobiuspi_lib` library. This library is used to retrieve MobiusPi' s runtime status and call MobiusPi' s physical interfaces.

1.2.2 Installation SDK

InHand Networks provides the software development kit (SDK) that includes the `mobiuspi_lib` library. Please contact our customer services if you want to obtain MobiusPi' s SDK and its feature information. For more information about how to install and upgrade the SDK, see IG902 Updated Software Versions.

1.2.3 Python requirements

The MobiusPi Python SDK is applicable to Python 3.7 and 3.8. If you use other Python versions, code execution may be abnormal. You can access the command prompt or start python IDE and run the `python` command to view your Python version. The content of this document is based on Python 3.7 and 3.8.



1.2.4 1. Basic

Getting started

The following example shows how to restart MobiusPi.

```
# Import the Basic class
from mobiuspi_lib.basic import Basic

# Create a basic instance
basic = Basic()

# Restart MobiusPi
print("will reboot ...")
r = basic.reboot()
print("reboot : %s" % r)
```

Instructions for use

You can use the Basic class as an instance, within a class or by subclassing. The general usage flow is as follows:

- Create a `basic` instance
- Use `reboot()` to restart MobiusPi

Method description

reboot()

Description

Use this method to restart MobiusPi.

Request parameters

None

Returns

- Return type

  str

- Return value

```
ok
```

- Return value description
  - `ok`: MobiusPi is restarted successfully.
  - `failed`: MobiusPi cannot be restarted.

1.2.5 2. Cellular

Getting started

The following example shows how to retrieve the MobiusPi cellular information:

```
# Import the Cellular class
from mobiuspi_lib.cellular import Cellular

# Create a cellular instance
cellular = Cellular()

# Retrieve modem information
modem = cellular.get_modem()
print("get modem: %s" % modem)
```

Output result of the example:

```
get modem: {
    "active_sim": "SIM 1",
    "imei_code": "811622048741556",
    "imsi_code": "411220441893359",
    "iccid_code": "84463317227780999882",
    "phone_number": "+8611162203133",
    "signal_level": 0,
    "dbm": 113,
    "rerp": 0,
    "rerq": 0,
    "register_status": 0,
    "operator": "CHN-CT",
    "apns": "",
    "network_type": "4G",
    "lac": "BB00",
```

(continues on next page)

(continued from previous page)

```
    "cell_id": "DD788B81"
}
```

Instructions for use

You can use the Cellular class as an instance, within a class or by subclassing. The general usage flow is as follows:

- Create a `cellular` instance
- Use `get_modem()` to retrieve the modem status
- Use `get_network()` to retrieve network connection information

Method description

get_modem()

Description

Use this method to retrieve the modem status.

Request parameters

None

Returns

- Return type

  dict

- Return value

```
{
    "active_sim": "SIM 1",
    "imei_code": "811622048741556",
    "imsi_code": "411220441893359",
    "iccid_code": "84463317227780999882",
    "phone_number": "+8611162203133",
    "signal_level": 0,
    "dbm": 113,
```

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```
    "rerp": 0,
    "rerq": 0,
    "register_status": 0,
    "operator": "CHN-CT",
    "apns": "",
    "network_type": "4G",
    "lac": "BB00",
    "cell_id": "DD788B81"
}
```

- Return value description
  - `active_sim`(string): current SIM card.
  - `imei_code`(string): international mobile equipment identity (IMEI). A `null string` is returned if the IMEI cannot be retrieved.
  - `imsi_code`(string): international mobile subscriber identity (IMSI). A `null string` is returned if the IMSI cannot be retrieved.
  - `iccid_code`(string): integrated circuit card identifier (ICCID). A `null string` is returned if the ICCID cannot be retrieved.
  - `phone_number`(string): phone number. A `null string` is returned if the phone number cannot be retrieved.
  - `signal_level`(int): signal value.
  - `dbm`(int): value, in the unit of dBm.
  - `rerp`(int): reference signal received power (RSRP), reserved.
  - `rerq`(int): reference signal received quality (RSRQ), reserved.
  - `register_status`(int): registration status.
    - `0`: Network registration is in progress.
    - `1`: Network registration is successful.
    - `5`: Network registration is successful, and the user is in the roaming state.
    - `6`: Network registration is not completed.
    - `7`: Unregistered.
  - `operator`(string): Operator. A `null string` is returned if the operator name cannot be retrieved.
  - `apns`(string): access point name (APN), reserved.

- `network_type`(string): network type. A `null string` is returned if the network type cannot be retrieved.
- `lac`(string): location area code (LAC). A `null string` is returned if the LAC cannot be retrieved.
- `cell_id`(string): cell ID. A `null string` is returned if the cell ID cannot be retrieved.

Exception

When the request times out, the following error message is returned:

```
KeyError: 'Connection Timeout'
```

get_network()

Description

Use this method to retrieve the network connection information.

Request parameters

None

Returns

- Return type

  list

- Return value

```
[
{
    'status': 0,
    'ip_addr': '0.0.0.0',
    'netmask': '0.0.0.0',
    'gateway': '0.0.0.0',
    'dns': '0.0.0.0',
    'mtu': 1200,
    'connect_time': 0
}]
```

- Return value description

- `status`(int): network status
  - 0: network not connected
  - 1: network connected
- `ip_addr`(string): IP address
- `netmask`(string): subnet mask
- `gateway`(string): gateway
- `dns`(string): domain name server (DNS)
- `mtu`(int): maximum transmission unit (MTU)
- `connect_time`(int): connection time, in the unit of seconds

Exception

When the request times out, the following error message is returned:

```
KeyError: 'Connection Timeout'
```

1.2.6 3. Config

Getting started

The following example shows how to retrieve the app path and its configuration file path:

```
# Import the Config class
from mobiuspi_lib.config import Config

# Create a config instance, which corresponds to the app name HelloWorld. If no app␣
↪exists in the /var/user/app/ path when the config class is instantiated, the error␣
↪message "FileExistsError: Invalid app_name, do not find app HelloWorld" is returned.
config = Config(app_name="HelloWorld")

# Retrieve the app path
get_app_path = config.get_app_path()
print("get_app_path: %s" % get_app_path)

# Retrieve the path of the app configuration folder
get_app_cfg_path = config.get_app_cfg_path()
print("get_app_cfg_path: %s" % get_app_cfg_path)
```

Output result of the example:

```
get_app_path: /var/user/app/HelloWorld
get_app_cfg_path: /var/user/cfg/HelloWorld
```

Instructions for use

You can use the Config class as an instance, within a class or by subclassing. The general usage flow is as follows:

- Create a `config` instance
- Use `get_app_path()` to retrieve the app path
- Use `get_app_cfg_path()` to retrieve the path of the app configuration folder

Method description

get_app_path()

Description

Use this method to retrieve the app path.

Request parameters

None

Returns

- Return type

  str

- Return value

  ```
  /var/user/app/HelloWorld
  ```

get_app_log_path()

Description

Use this method to retrieve the app log file path.

Request parameters

None

Returns

- Return type

  str

- Return value

```
/var/user/log/HelloWorld
```

get_app_cfg_path()

Description

Use this method to retrieve the path of the app configuration folder.

Request parameters

None

Returns

- Return type

  str

- Return value

```
/var/user/cfg/HelloWorld
```

get_app_cfg_file()

Description

Use this method to retrieve the path of the current app configuration file.

Request parameters

None

Returns

- Return type

  str

- Return value

```
/var/user/app/HelloWorld/config.yaml
```

get_default_app_cfg_file()

Description

Use this method to retrieve the path of the default app configuration file.

Request parameters

None

Returns

- Return type

  str

- Return value

```
/var/user/app/HelloWorld/config.yaml
```

get_app_db_base_path()

Description

Use this method to retrieve the home path of the database.

Request parameters

None

Returns

- Return type

  str

- Return value

```
/var/user/data/dbhome
```

get_app_db_path()

Description

Use this method to retrieve the app database path.

Request parameters

None

Returns

- Return type

  str

- Return value

```
/var/user/data/dbhome/HelloWorld
```

1.2.7 4. GPS

Getting started

The following example shows how to retrieve the GPS information:

```
# Import the GPS class
from mobiuspi_lib.gps import GPS

# Create a gps instance
gps = GPS()

# Retrieve GPS information
position_status = gps.get_position_status()
print("position_status: ")
print(position_status)
```

Output result of the example:

```
position_status: {
    'gps_enable': 1,
    'gps_time': '2020-06-10  09:31:25',
    'latitude': "30° 35.276870' N",
    'longitude': "104° 3.251330' E",
    'speed': '0.3500 Knots (1knot = 1.852km/h)'
}
```

Instructions for use

You can use the GPS class as an instance, within a class or by subclassing. The general usage flow is as follows:

- Create a `gps` instance
- Use `get_position_status()` to retrieve GPS information

Method description

get_position_status()

Description

Use this method to retrieve MobiusPi' s GPS information.

Request parameters

None

Returns

- Return type

  dict

- Return value

```
{
  'gps_enable': 1,
  'gps_time': '2020-06-10  09:31:25',
  'latitude': "30° 35.276870' N",
  'longitude': "104° 3.251330' E",
  'speed': '0.3500 Knots (1knot = 1.852km/h)'
}
```

- Return value description
  - `gps_enable`: specifies whether GPS is enabled.
    - `0`: GPS is not enabled.
    - `1`: GPS is enabled.
  - `gps_time`: positioning time.
  - `latitude`: latitude. A `null string` is returned if the latitude cannot be retrieved.
  - `longitude`: longitude. A `null string` is returned if the longitude cannot be retrieved.
  - `speed`: speed.

Exception

When the request times out, the following error message is returned:

```
KeyError: 'Connection Timeout'
```

1.2.8 5. I/O

Getting started

The following example shows how to retrieve the I/O name, specify the input I/O mode, read the I/O status, and modify the output I/O:

```
# Import the I/O class and variables used by I/O-related methods
from mobiuspi_lib.io import IO, DIGITAL_DRY_CONTACT_MODE, DIGITAL_WET_CONTACT_MODE, DRY_
↪CONTACT_HIGH_VALUE, SHUT_DOWN_MODE, DRY_CONTACT_LOW_VALUE, ANALOG_LOW_A_MODE, ANALOG_
↪HIGH_A_MODE, ANALOG_LOW_V_MODE, and ANALOG_HIGH_V_MODE

# Create an io instance
io = IO()

# Retrieve all I/O names
io_list = io.get_io_list()
print("io_list: %s " % io_list)

# Set the digital input I/O mode
sdi = io.setup_digital_io(io_name="di0", mode=DIGITAL_DRY_CONTACT_MODE)
print("sdi: %s" % sdi)

# Read the I/O status
ri0 = io.read_io(io_name="di0")
print("ri0: %s" % ri0)

# Modify the output I/O
io.write_io(io_name="do0", value=DRY_CONTACT_HIGH_VALUE)
ro0 = io.read_io(io_name="do0")
print("ro0: %s" % ro0)
```

Output result of the example:

```
io_list: ['di0', 'di1', 'di2', 'di3', 'do0', 'do1', 'ai0', 'ai1']
sdi: {'index': 0, 'name': 'di0', 'type': 'digital input', 'mode': 'drycontact'}
ri0: LOW
ro0: ON
```

Note: Only devices with model IG902 and IO support AI support this API. For other models, please refer to the I/O Module for information on obtaining IO status.

Instructions for use

You can use the IO class as an instance, within a class or by subclassing. The general usage flow is as follows:

- Create an `io` instance
- Use `get_io_list()` to retrieve all I/O names

- Use `setup_digital_io()` to set the digital input I/O mode
- Use `setup_analog_io()` to set the analog input I/O mode
- Use `read_io(io_name="")` to retrieve the I/O status
- Use `write_io()` to modify the digital output I/O status

Method description

get_io_list()

Description

Use this method to retrieve all I/O names.

Request parameters

None

Returns

- Return type

  list

- Return value

```
['di0', 'di1', 'di2', 'di3', 'do0', 'do1', 'ai0', 'ai1']
```

- Return value descriptiondi0 to di3 specify digital inputs DIO to DI3. do0 and do1 specify digital outputs DO0 and DO1. ai0 and ai1 specify analog inputs AI0 and AI1.

Exception

When the request times out, the following error message is returned:

```
KeyError: 'Connection Timeout'
```

get_io_info(io_name)

Description

Use this method to retrieve the type and mode of a specific I/O.

Request parameters

- `io_name`: I/O name

Returns

- Return type

  dict

- Return value

```
{
  'index': 0,
  'name': 'di0',
  'type': 'digital input',
  'mode': 'drycontact'
}
```

- Return value description
  - `index`: index
  - `name`: I/O name
  - `type`: I/O type
    - `digital input`: digital input
    - `digital output`: digital output
    - `analog input`: analog input
  - `mode`: I/O mode
    - Digital input I/O
      - `wetcontact`: wet contact
      - `drycontact`: dry contact
      - `shutdown`: shutdown
    - Digital output I/O
      - `connect`: connected
      - `break`: disconnected
    - Analog input I/O
      - `0_20mA`: 0 mA to 20 mA

- `4_20mA`: 4 mA to 20 mA
- `0_5V`: 0 V to 5 V
- `0_10V`: 0 V to 10 V
- `shutdown`: shutdown

Exception

- When io_name is set to an incorrect I/O name, such as `dd1`, the following error message is returned:

```
KeyError: 'Invalid io_name'
```

- When the request times out, the following error message is returned:

```
KeyError: 'Connection Timeout'
```

get_all_io_info()

Description

Use this method to retrieve the types and modes of all I/Os.

Request parameters

None

Returns

- Return type

  list

- Return value

```
[{
    'index': 0,
    'name': 'di0',
    'type': 'digital input',
    'mode': 'drycontact'
}, {
    'index': 1,
```

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```
    'name': 'di1',
    'type': 'digital input',
    'mode': 'wetcontact'
}, {
    'index': 2,
    'name': 'di2',
    'type': 'digital input',
    'mode': 'shutdown'
}, {
    'index': 3,
    'name': 'di3',
    'type': 'digital input',
    'mode': 'drycontact'
}, {
    'index': 0,
    'name': 'do0',
    'type': 'digital output',
    'mode': 'connect'
}, {
    'index': 1,
    'name': 'do1',
    'type': 'digital output',
    'mode': 'break'
}, {
    'index': 0,
    'name': 'ai0',
    'type': 'analog input',
    'mode': '4_20mA'
}, {
    'index': 1,
    'name': 'ai1',
    'type': 'analog input',
    'mode': '0_5V'
}]
```

- Return value description
  - `index`: index
  - `name`: I/O name
  - `type`: I/O type

        * `digital input`: digital input
        * `digital output`: digital output
        * `analog input`: analog input
    - `mode`: I/O mode
        * Digital input I/O
            · `wetcontact`: wet contact
            · `drycontact`: dry contact
            · `shutdown`: shutdown
        * Digital output I/O
            · `connect`: connected
            · `break`: disconnected
        * Analog input I/O
            · `0_20mA`: 0 mA to 20 mA
            · `4_20mA`: 4 mA to 20 mA
            · `0_5V`: 0 V to 5 V
            · `0_10V`: 0 V to 10 V
            · `shutdown`: shutdown

Exception

When the request times out, the following error message is returned:

```
KeyError: 'Connection Timeout'
```

setup_digital_io(io_name, mode)

Description

Use this method to set the digital input I/O mode.

Request parameters

- `io_name`: I/O name (only digital input I/O is supported)
- `mode`: digital input I/O mode

  - `DIGITAL_DRY_CONTACT_MODE`: dry contact mode
  - `DIGITAL_WET_CONTACT_MODE`: wet contact mode
  - `SHUT_DOWN_MODE`: shutdown

Returns

- Return type

  dict

- Return value

```
{
  'index': 0,
  'name': 'di0',
  'type': 'digital input',
  'mode': 'drycontact'
}
```

- Return value description
  - `index`: index
  - `name`: I/O name
  - `type`: I/O type
    - `digital input`: digital input
  - `mode`: I/O mode
    - `wetcontact`: wet contact
    - `drycontact`: dry contact
    - `shutdown`: shutdown

Exception

- When io_name is set to an incorrect I/O name, such as `dd1`, the following error message is returned:

```
KeyError: 'Invalid io_name'
```

- When the name of a digital output I/O or analog input I/O is entered, such as `do0`, the following error message is returned:

```
KeyError: 'Parameter Conflict'
```

- When an incorrect mode is entered, such as `1234`, the following error message is returned:

```
KeyError: 'Invalid mode'
```

- When the request times out, the following error message is returned:

```
KeyError: 'Connection Timeout'
```

- When MobiusPi is busy, the following error message is returned:

```
KeyError: 'Device Busy'
```

setup_analog_io(io_name, mode)

Description

Use this method to set the analog input I/O mode.

Request parameters

- `io_name`: I/O name (only analog input I/O is supported)
- `mode`: analog input I/O mode
  - `ANALOG_LOW_A_MODE`: 0-20 mA mode
  - `ANALOG_HIGH_A_MODE`: 4-20 mA mode
  - `ANALOG_LOW_V_MODE`: 0-5 V mode
  - `ANALOG_HIGH_V_MODE`: 0-10 V mode
  - `SHUT_DOWN_MODE`: shutdown

Returns

- Return type

  dict

- Return value

```
{
  'index': 0,
  'name': 'ai0',
  'type': 'analog input',
  'mode': '4_20mA'
}
```

- Return value description
  - `index`: index
  - `name`: I/O name
  - `type`: I/O type
    - `analog input`: analog input
  - `mode`: I/O mode
    - `0_20mA`: 0 mA to 20 mA
    - `4_20mA`: 4 mA to 20 mA
    - `0_5V`: 0 V to 5 V
    - `0_10V`: 0 V to 10 V
    - `shutdown`: shutdown

Exception

- When io_name is set to an incorrect I/O name, such as `dd1`, the following error message is returned:

```
KeyError: 'Invalid io_name'
```

- When the name of a digital input or output I/O is entered, such as `do0`, the following error message is returned:

```
KeyError: 'Parameter Conflict'
```

- When an incorrect mode is entered, such as `1234`, the following error message is returned:

```
KeyError: 'Invalid mode'
```

- When the request times out, the following error message is returned:

```
KeyError: 'Connection Timeout'
```

- When MobiusPi is busy, the following error message is returned:

```
KeyError: 'Device Busy'
```

read_io(io_name)

Description

Use this method to read the I/O status.

Request parameters

- `io_name`: I/O name

Returns

- Return type

  str

- Return value

```
LOW
```

- Return value description
  - `ON`
    - `ON` is returned when the digital input I/O mode is wet contact and the input voltage ranges from 10 V to 30 V.
    - `ON` is returned when the digital output I/O is connected.
  - `OFF`
    - `OFF` is returned when the digital input I/O mode is wet contact and the input voltage ranges from 0 V to 3 V.
    - `OFF` is returned when the digital output I/O is disconnected.
  - `LOW`: `LOW` is returned when the digital input I/O mode is dry contact and disconnected.
  - `HIGH`: `HIGH` is returned when the digital input I/O mode is dry contact and connected.
  - Current or voltage of analog input

Exception

- When io_name is set to an incorrect I/O name, such as `dd1`, the following error message is returned:

```
KeyError: 'Invalid io_name'
```

- When the request times out, the following error message is returned:

```
KeyError: 'Connection Timeout'
```

write_io(io_name)

Description

Use this method to modify the digital output I/O status.

Request parameters

- `io_name`: name of a digital output I/O.
- `value`: value of the digital output I/O.
  - `DRY_CONTACT_LOW_VALUE`: Set the digital output I/O to the disconnected state.
  - `DRY_CONTACT_HIGH_VALUE`: Set the digital output I/O to the connected state.

Returns

- Return type

  str

- Return value

```
TRUE
```

- Return value description
  - TRUE: Settings are successfully delivered

Exception

- When io_name is set to an incorrect I/O name, such as `dd1`, the following error message is returned:

```
KeyError: 'Invalid io_name'
```

- When the name of a digital input I/O or analog input I/O is entered, such as `do0`, the following error message is returned:

```
KeyError: 'Invalid Parameter'
```

- When an incorrect value is entered, such as `1234`, the following error message is returned:

```
KeyError: 'Invalid value'
```

- When the request times out, the following error message is returned:

```
KeyError: 'Connection Timeout'
```

- When MobiusPi is busy, the following error message is returned:

```
KeyError: 'Device Busy'
```

1.2.9 6. Serial

Getting started

The following example shows how to retrieve the 232 or 485 serial port path:

```
# Import the Serial class
from mobiuspi_lib.serial import Serial

# Create a Serial instance
serial = Serial()

# Retrieve the 232 serial port path
path_232 = serial.get_serial232_path()
print("232 path: %s" % path_232)

# Retrieve the 485 serial port path
path_485 = serial.get_serial485_path()
print("485 path: %s" % path_485)
```

Output result of the example:

```
232 path: /dev/ttyO1
485 path: /dev/ttyO3
```

Instructions for use

You can instantiate the `Serial` class or its subclass. Procedure:

- Create an `serial` instance
- Use `get_serial232_path()` to retrieve the 232 serial port path.
- Use `get_serial485_path()` to retrieve the 485 serial port path.

Method description

get_serial232_path()

Description

Use this method to retrieve the 232 serial port path.

Request parameters

None

Returns

- Return type

  str

- Return value

  ```
  /dev/ttyO1
  ```

- Return value description
  - `/dev/ttyO5`: This value is returned when IG501 is used.
  - `/dev/ttyO1`: This value is returned when IG902 is used.

Exception

When the request times out, the following error message is returned:

```
KeyError: 'Connection Timeout'
```

get_serial485_path()

Description

Use this method to retrieve the 485 serial port path.

Request parameters

None

Returns

- Return type

  str

- Return value

  ```
  /dev/ttyO3
  ```

- Return structure
  - `/dev/ttyO1`: This value is returned when IG501 is used.
  - `/dev/ttyO3`: This value is returned when IG902 is used.

Exception

When the request times out, the following error message is returned:

```
KeyError: 'Connection Timeout'
```

1.2.10 7. SystemInfo

Getting started

The following example shows how to retrieve the MobiusPi system information:

```
# Import the SystemInfo class
from mobiuspi_lib.systeminfo import SystemInfo

# Create a sysinfo instance
sysinfo = SystemInfo()

# Retrieve the MobiusPi system information
get_system_info = sysinfo.get_system_info()
print("get system info: %s" % get_system_info)
```

Output result of the example:

```
get system info: {
    'language': 'Chinese',
    'hostname': 'InGateway',
    'model_name': 'IG902H',
    'oem_name': 'inhand',
    'serial_number': 'GT902XXXXXXXXXX',
    'mac_addr1': '00:XX:XX:XX:XX:XX',
    'mac_addr2': '00:XX:XX:XX:XX:XX',
    'firmware_version': '2.0.0.r12644',
    'bootloader_version': '2017.01.r10517',
    'product_number': 'TH09-W-RE',
    'description': 'www.inhand.com.cn',
    'auto_save': 1,
    'encrypt_passwd': 1
}
```

Instructions for use

You can use the SystemInfo class as an instance, within a class or by subclassing. The general usage flow is as follows:

- Create an `sysinfo` instance
- Use `get_system_info()` to retrieve the MobiusPi system information

Method description

get_system_info()

Description

Use this method to retrieve the MobiusPi system information.

Request parameters

None

Returns

- Return type

  dict

- Return value

```
{
  'language': 'Chinese',
  'hostname': 'InGateway',
  'model_name': 'IG902H',
  'oem_name': 'inhand',
  'serial_number': 'GT902XXXXXXXXX',
  'mac_addr1': '00:XX:XX:XX:XX:XX',
  'mac_addr2': '00:XX:XX:XX:XX:XX',
  'firmware_version': '2.0.0.r12644',
  'bootloader_version': '2017.01.r10517',
  'product_number': 'TH09-W-RE',
  'description': 'www.inhand.com.cn',
  'auto_save': 1,
  'encrypt_passwd': 1
}
```

- Return value description
  - `language`: language
    - `Chinese`: Chinese
    - `English`: English
  - `hostname`: MobiusPi name
  - `model_name`: MobiusPi model
  - `oem_name`: OEM name
  - `serial_number`: MobiusPi serial number

- `mac_addr1`: MAC address 1 of MobiusPi
- `mac_addr2`: MAC address 2 of MobiusPi
- `firmware_version`: firmware version
- `bootloader_version`: bootloader version
- `product_number`: product number
- `description`: product description
- `auto_save`: whether to automatically save modified configurations
  - `0`: not automatically save modified configurations
  - `1`: automatically save modified configurations
- `encrypt_passwd`: whether to encrypt plaintext passwords
  - `0`: not encrypt plaintext passwords
  - `1`: encrypt plaintext passwords

Exception

When the request times out, the following error message is returned:

```
KeyError: 'Connection Timeout'
```