

QR code creation and recognition

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- 5.1. QR QR code
 - 5.1.1. Introduction to QR QR code
 - 5.1.2. QR QR code structure
 - 5.1.3. Characteristics of QR QR code
- 5.2, Program Function Description
- 5.3, Program code reference path
- 5.4, Program Startup
 - 5.4.1, Create QR Code
 - 5.4.2, QR code recognition
- 5.5, core source code analysis
 - 5.5.1、QRcode_Create.py
 - 5.5.2, QRcode_Parsing.py

5.1. QR QR code

5.1.1. Introduction to QR QR code

QR code is a type of two-dimensional barcode. QR comes from the abbreviation of "Quick Response" in English, which means quick response. It comes from the inventor's hope that QR code can allow its content to be decoded quickly. QR code not only has large information capacity, high reliability and low cost, but also can represent a variety of text information such as Chinese characters and images. It has strong confidentiality and anti-counterfeiting properties and is very convenient to use. More importantly, the QR code technology is open source.

5.1.2. QR QR code structure

Picture	Analysis
	(Positioning markings) Indicate the orientation of the QR code.
	(Alignment markings) If the QR code is large, these additional elements help with positioning.
	(Timing pattern) With these lines, the scanner can identify how big the matrix is.
	(Version information) This specifies the version of the QR code being used. There are currently 40 different versions of QR codes. Versions used in the sales industry are usually 1-7.
	(Format information) The format pattern contains information about error tolerance and data mask patterns and makes scanning the code easier.
	(Data and error correction keys) These patterns hold the actual data.
	(Quiet zone) This area is very important for the scanner, its role is to separate itself from the surroundings.

5.1.3. Characteristics of QR QR code

The data value in the QR code contains repeated information (redundant value). Therefore, even if up to 30% of the QR code structure is destroyed, it does not affect the readability of the QR code. The storage space of the QR code is up to 7089 bits or 4296 characters, including punctuation and special characters, which can be written into the QR code. In addition to numbers and characters, words and phrases (such as URLs) can also be encoded. As more data is added to the QR code, the code size increases and the code structure becomes more complex.

5.2, Program Function Description

After running the QR code creation program, enter the QR code content to generate a QR code image and save it locally.

After running the QR code recognition program, the created QR code image will be read and recognized, the recognition result will be output and the image will be saved locally.

The image can be visualized by configuring VSCode to connect with the car.

5.3, Program code reference path

After SSH connects to the car, the source code of this function is located at,

```
/home/sunrise/yahboomcar_ws/src/yahboomcar_astra/qrcode_examples
```

The command to install the required package is,

```
python3 -m pip install qrcode pyzbar  
sudo apt-get install libzbar-dev
```

The factory system image has been installed.

5.4, Program Startup

5.4.1, Create QR Code

After SSH connects to the car, open the terminal and input,

```
#Switch to the directory where the code is located  
cd /home/sunrise/yahboomcar_ws/src/yahboomcar_astra/qrcode_examples  
#Run the QR code creation program  
python3 QRcode_Create.py
```

After the program runs, you will be prompted to enter the generated content, and press Enter to confirm the content. Here we take the creation of the "yahboom" string as an example,

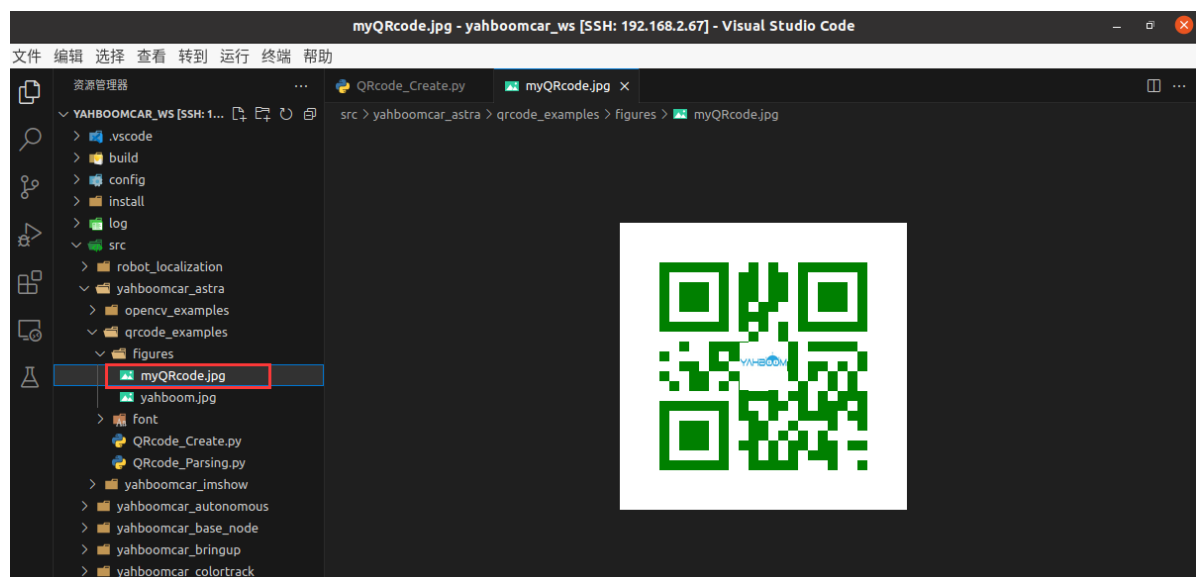
```
root@ubuntu:~# cd /home/sunrise/yahboomcar_ws/src/yahboomcar_astra/qrcode_examples  
root@ubuntu:~/yahboomcar_ws/src/yahboomcar_astra/qrcode_examples# python3 QRcode_Create.py  
Please enter : yahboom
```

The created QR code is saved in the path,

```
/home/sunrise/yahboomcar_ws/src/yahboomcar_astra/qrcode_examples/figures/myQRcode.jpg
```

Remotely connect to the car in VSCode, enter the

/home/sunrise/yahboomcar_ws/src/yahboomcar_astra/qrcode_examples/figures directory, you can click on the picture to view the QR code,



Take out your phone and try to scan the displayed QR code, the scan result will be the characters of yahboom.

5.4.2, QR code recognition

After SSH connects to the car, open the terminal and input,

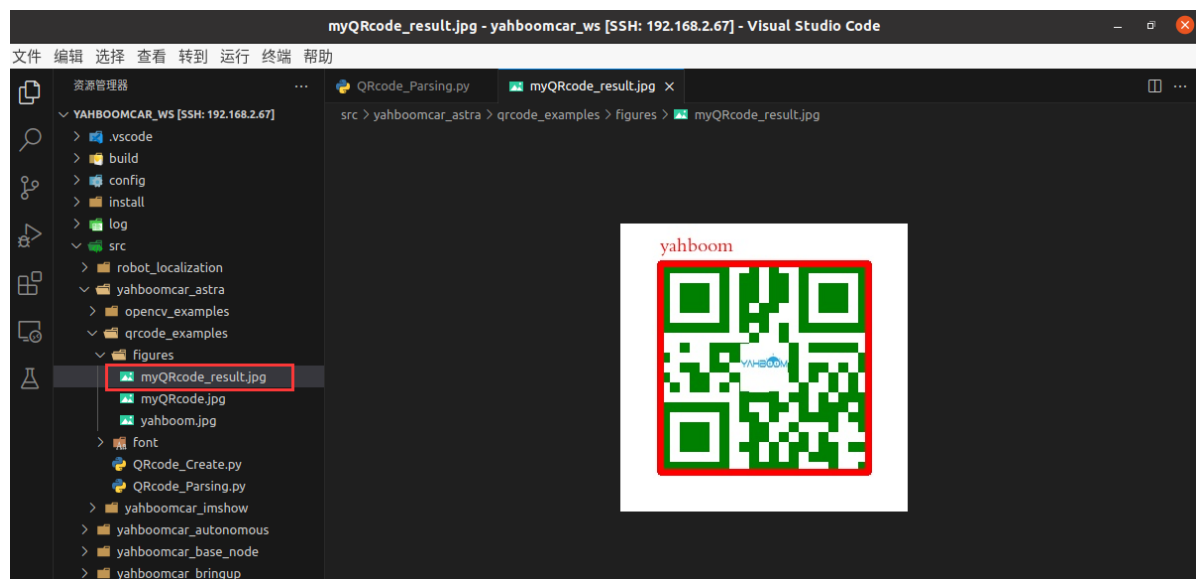
```
#Switch to the directory where the code is located
cd /home/sunrise/yahboomcar_ws/src/yahboomcar_astra/qrcode_examples
#Run the QR code recognition program
python3 QRcode_Parsing.py
```

```
root@ubuntu:~# cd /userdata/yahboomcar_ws/src/yahboomcar_astra/qrcode_examples
root@ubuntu:/userdata/yahboomcar_ws/src/yahboomcar_astra/qrcode_examples# python3 QRcode_Parsing.py
[INFO] Found QRCODE barcode: yahboom
root@ubuntu:/userdata/yahboomcar_ws/src/yahboomcar_astra/qrcode_examples#
```

The program will print out the recognized content in the terminal and save the recognition result image to the path,

```
/home/sunrise/yahboomcar_ws/src/yahboomcar_astra/qrcode_examples/figures/myQRcode_result.jpg
```

SSH connect to the car in VSCode, enter the /home/sunrise/yahboomcar_ws/src/yahboomcar_astra/qrcode_examples/figures directory, you can click on the image to view the QR code,



5.5, core source code analysis

5.5.1、QRcode_Create.py

```
#Create qrcode object
qr = qrcode.QRCode(
    version=1,
    error_correction=qrcode.constants.ERROR_CORRECT_H,
    box_size=10,
    border=4,)
#Meaning of each parameter
'''version: An integer with a value of 1 to 40, which controls the size of the QR
code (the minimum value is 1, which is a 12x12 matrix).
```

If you want the program to determine it automatically, set the value to None and use the fit parameter.

error_correction: Controls the error correction function of the QR code. The following 4 constants can be used.

ERROR_CORRECT_L: About 7% or less errors can be corrected.

ERROR_CORRECT_M (default): About 15% or less errors can be corrected.

ERROR_CORRECT_H: About 30% or less errors can be corrected.

box_size: controls the number of pixels contained in each small grid in the QR code.

border: controls the number of grids contained in the border (the distance between the QR code and the image border) (the default is 4, which is the minimum value specified by the relevant standards)'''

```
# Generate image
img = qr.make_image(fill_color="green", back_color="white")
# Add data
qr.add_data(data)
# Fill data
qr.make(fit=True)
# Add logo
my_file = Path(logo_path)
if my_file.is_file(): img = add_logo(img, logo_path)
```

5.5.2, Qrcode_Parsing.py

```
def decodeDisplay(image, font_path):
    gray = cv.cvtColor(image, cv.COLOR_BGR2GRAY)
    # You need to convert the output Chinese characters into Unicode encoding format first
    barcodes = pyzbar.decode(gray)
    for barcode in barcodes:
        # Extract the position of the bounding box of the QR code
        (x, y, w, h) = barcode.rect
        # Draw the bounding box of the barcode in the image
        cv.rectangle(image, (x, y), (x + w, y + h), (225, 0, 0), 5)
        encoding = 'UTF-8'
        # Draw it, you need to convert it into a string first
        barcodeData = barcode.data.decode(encoding)
        barcodeType = barcode.type
        # Draw the data and type on the image
        pilimg = Image.fromarray(image)
        # Create a brush
        draw = ImageDraw.Draw(pilimg)
        # Parameter 1: font file path, parameter 2: font size
        fontStyle = ImageFont.truetype(font_path, size=20, encoding=encoding)
        # Parameter 1: print coordinates, parameter 2: text, parameter 3: font color, parameter 4: font
        draw.text((x, y - 30), str(barcode.data, encoding), fill=(0, 0, 255), font=fontStyle)
        # Convert PIL image to cv2 image
        image = np.array(pilimg)
        # Print barcode data and barcode type to the terminal
        print("[INFO] Found {} barcode: {}".format(barcodeType, barcodeData))
    return image
```

