2. QR code creation and recognition

2.1. QR code

2.1.1. Introduction to 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 the QR code can allow its content to be decoded quickly. QR code not only has large information capacity, high reliability and low cost, but can also represent various text information such as Chinese characters and images. It has strong confidentiality and anti-counterfeiting and is very convenient to use. What's more important is that the QR code technology is open source.

2.1.2. Structure of QR code

图片	解析
	**定位标识**（Positioning markings）标明二维码的方向。
	**对齐标记**（Alignment markings）如果二维码很大，这些附加元素帮助定位。
	**计算模式**（Timing pattern）通过这些线，扫描器可以识别矩阵有多大。
	**版本信息**（Version information）这里指定正在使用的QR码的版本号，目前有QR码有40个不同的版本号。 用于销售行业的的版本号通常为1-7。
	**格式信息**（Format information）格式模式包含关于容错和数据掩码模式的信息，并使得扫描代码更加容易。
	**数据和错误校正值**（Data and error correction keys）这些模式保存实际数据。
	**宁静区域**（Quiet zone）这个区域对于扫描器来说非常重要，它的作用就是将自身与周边的进行分离。

2.1.3. Characteristics of QR code

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

2.1.4. QR code creation and recognition

1). Create QR code

- Source code path

```
~/orbbec_ws/src/yahboomcar_visual/simple_qrcode/QRcode_Create.py
```

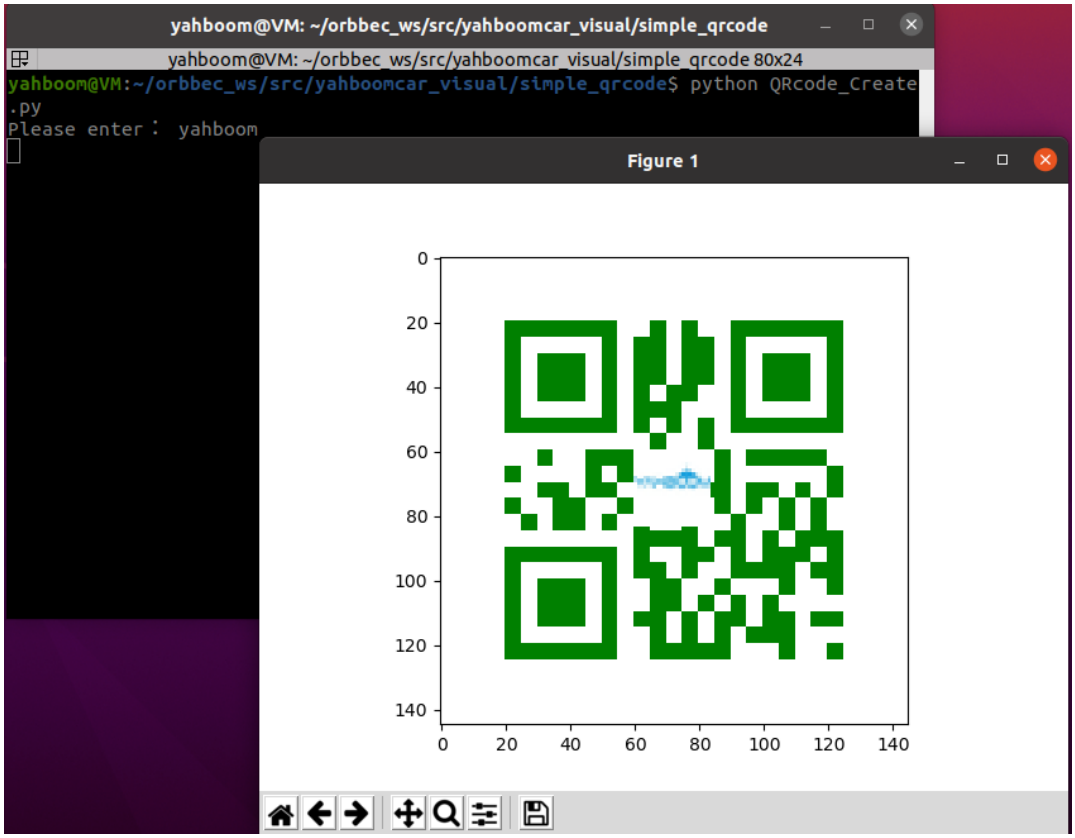
- Installation package

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

- start up

```
cd ~/orbbec_ws/src/yahboomcar_visual/simple_qrcode
pythonQRcode_Create.py
```

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



- Core source code analysis

```
#Create qrcode object
qr = qrcode.QRCode(
version=1,
error_correction=qrcode.constants.ERROR_CORRECT_H,
box_size=5,
border=4,)
#Meaning of each parameter
'''version: an integer with a value of 1~40, controlling the size of the
QR code (the minimum value is 1, which is a 12×12 matrix).
If you want the program to determine this automatically, set the value
to None and use the fit argument.
error_correction: Controls the error correction function of the QR code.
Possible values are the following 4 constants.
ERROR_CORRECT_L: Approximately 7% or less of errors can be corrected.
ERROR_CORRECT_M (default): About 15% or less of errors can be corrected.
ROR_CORRECT_H: About 30% or less of errors can be corrected.
box_size: Controls the number of pixels contained in each small grid in
the QR code.
border: Control the number of cells included in the border (the distance
between the QR code and the image border) (the default is 4, which is
the minimum value specified by relevant standards)'''
#qrcode QR code to add logo
my_file = Path(logo_path)
if my_file.is_file(): img = add_logo(img, logo_path)
#adding data
qr.add_data(data)
# Data input
# fill data
qr.make(fit=True)
# Generate pictures
# generate images
img = qr.make_image(fill_color="green", back_color="white")
```

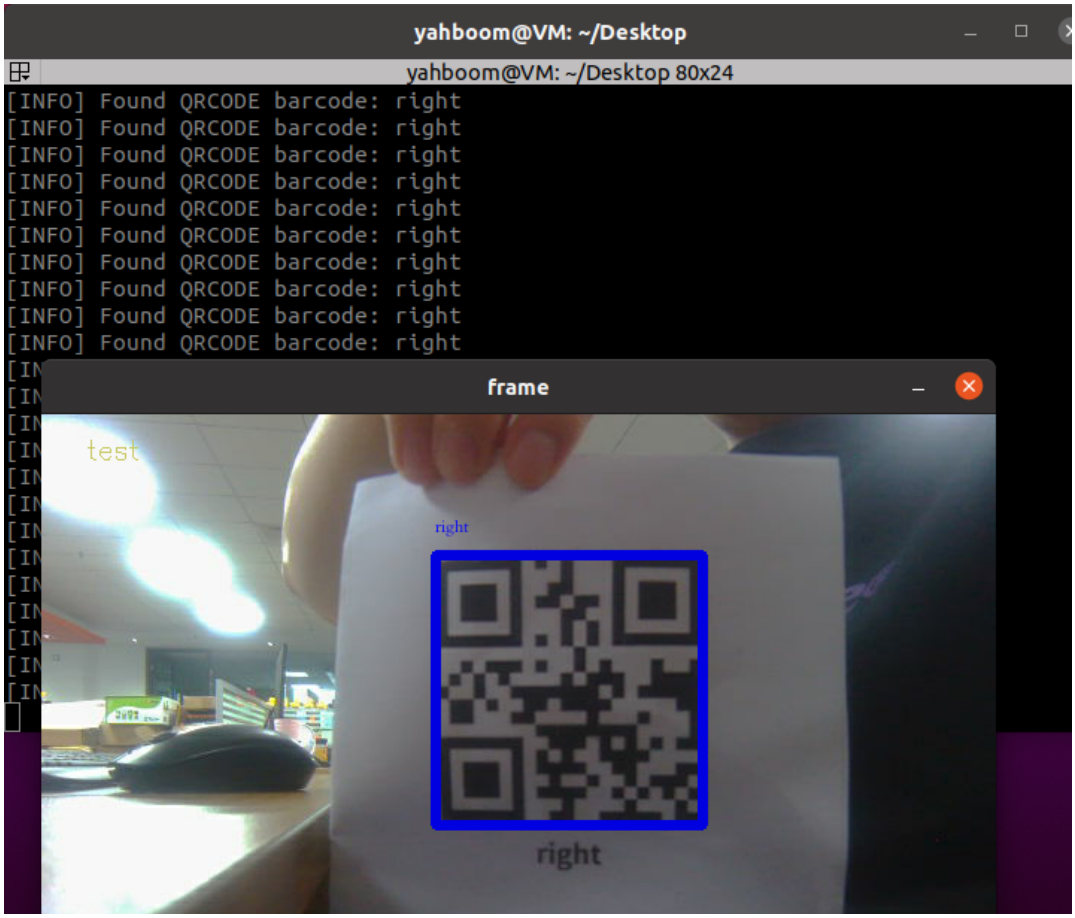
2) Recognize the QR code

- Source code path

```
~/orbbec_ws/src/yahboomcar_visual/yahboomcar_visual/QRcode_Parsing.py
```

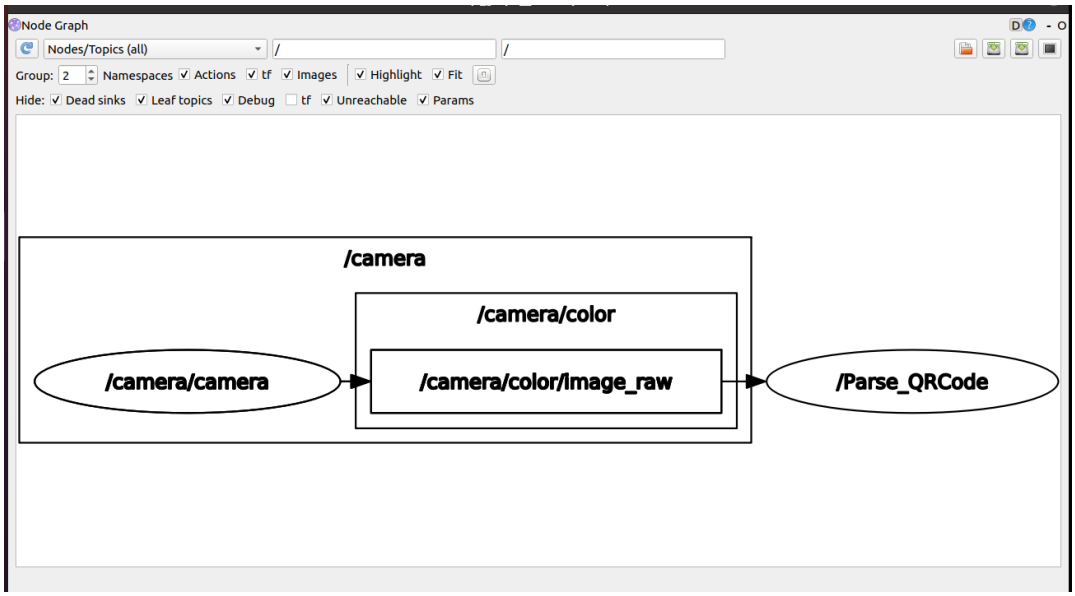
- start up

```
ros2 launch orbbec_camera gemini2.launch.py
ros2 run yahboomcar_visual QRcode_Parsing
```



- View node communication diagram

```
ros2 run rqt_graph rqt_graph
```



- Core source code analysis

```
#subscribe to color image information
self.sub_img =
self.create_subscription(CamImage,'/camera/color/image_raw',self.handleT
opic,100)
#Pass the image data to the parsing image function in the callback
function
frame = self.decodeDisplay(frame)
#parse image
```

```
def decodeDisplay(self,image):
    gray = cv.cvtColor(image, cv.COLOR_BGR2GRAY)
    # You need to convert the output Chinese characters into Unicode
encoding first.
    # The output Chinese characters need to be converted to Unicode
encoding first
    barcodes = pyzbar.decode(gray)
    for barcode in barcodes:
        #Extract the position of the bounding box of the QR code
        # Extract the position of the boundary box of the TWO-
DIMENSIONAL code
        # Draw the bounding box of the barcode in the image
        # Draw the bounding box for the bar code in the image
        (x, y, w, h) = barcode.rect
        cv.rectangle(image, (x, y), (x + w, y + h), (225, 0, 0), 5)
        encoding = 'UTF-8'
        # To draw it, you need to convert it into a string first
        # to draw it, you need to convert it to a string
        barcodeData = barcode.data.decode(encoding)
        barcodeType = barcode.type
        # Draw the data and types on the image
        # Draw the data and type on the image
        pilimg = Image.fromarray(image)
        #Create brush
        # create brush
        draw = ImageDraw.Draw(pilimg) # Print on picture
        # Parameter 1: font file path, parameter 2: font size
        # parameter 1: font file path, parameter 2: font size
        fontStyle =
ImageFont.truetype("/home/yahboom/orbbec_ws/src/yahboomcar_visual/yahboo
mcar_visual/Block_Simplified.TTF", size=12, encoding=encoding)
        # # Parameter 1: print coordinates, parameter 2: text, parameter
3: font color, parameter 4: font
        # Parameter 1: print coordinates, parameter 2: text, parameter
3: font color, parameter 4: font
        draw.text((x, y - 25), str(barcode.data, encoding), fill=(255,
0, 0), font=fontStyle)
        # # PIL image to cv2 image
        # PIL picture to CV2 picture
        image = np.array(pilimg)
        # Print barcode data and barcode type to the terminal
        # Print barcode data and barcode type to terminal
        print("[INFO] Found {} barcode: {}".format(barcodeType,
barcodeData))
        return image
```