Machine code different height sorting

Before starting this function, you need to close the process of the big program and APP. Enter the following program in the terminal to close the process of the big program and APP,

```
sh ~/app_Arm/kill_YahboomArm.sh
sh ~/app_Arm/stop_app.sh
```

If you need to start the big program and APP again later, start the terminal,

```
sudo systemctl start yahboom_arm.service
sudo systemctl start yahboom_app.service
```

1. Function description

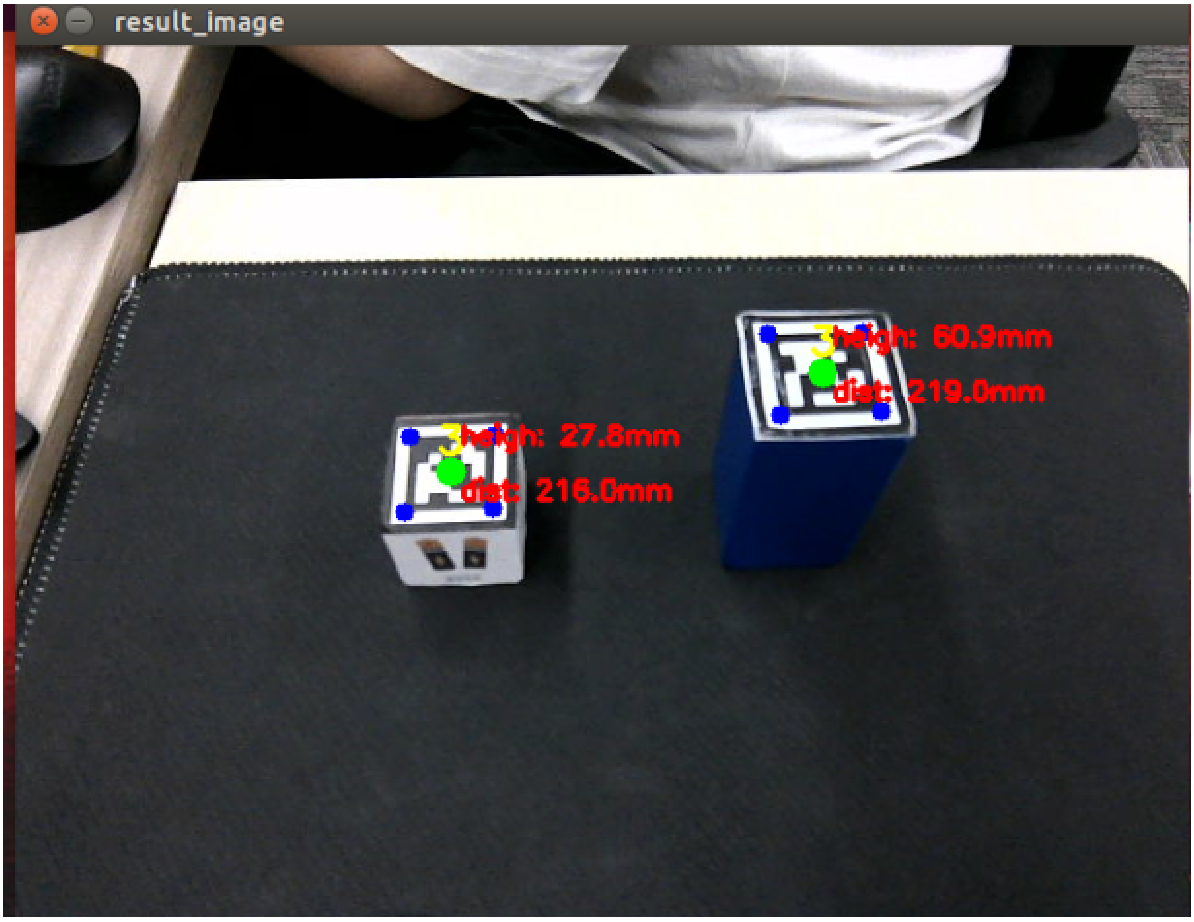
After the program is started, the camera recognizes the machine code, and it will clamp the machine code with a height higher than the set height and place it in the set position.

2. Start and operate

2.1. Start command

Terminal input,

```
#Start the camera
roslaunch orbbec_camera dabai_dcw2.launch
#Start the underlying control robot
rosrun dofbot_pro_info arm_driver.py
#Start the inverse solution program
rosrun dofbot_pro_info kinemarics_dofbot_pro
#Start the detection machine code recognition program
rosrun dofbot_pro_apriltag apriltag_list.py
#Start the robot arm to grab the machine code program
rosrun dofbot_pro_apriltag apriltag_remove_higher.py
```



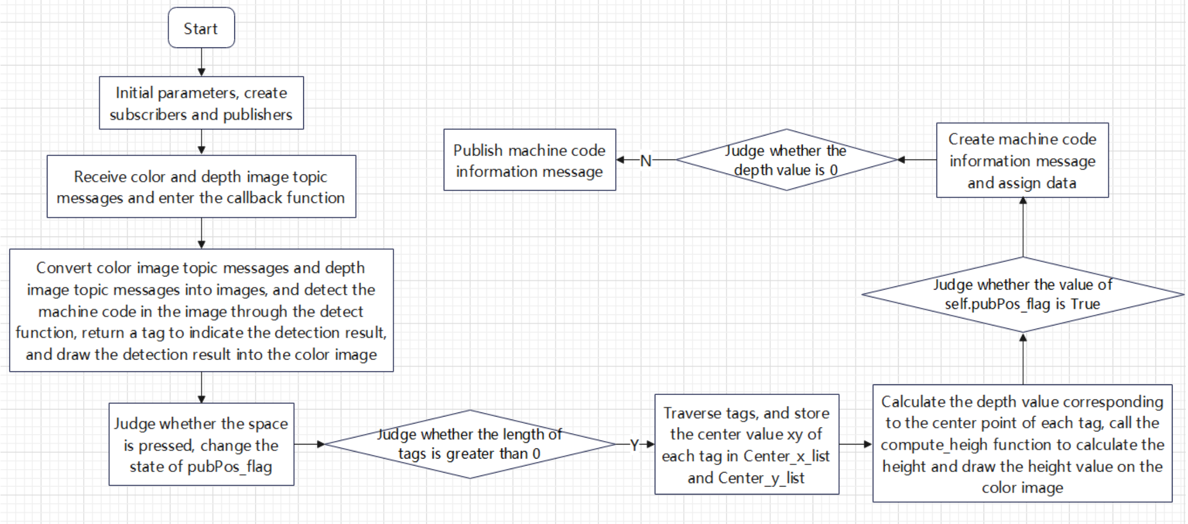
2.2. Operation

Click the image frame with the mouse, and then press the space bar on the keyboard. The robot arm will grab the machine code wooden block that is higher than the set height, and then place it in the set position. After the placement is completed, it will return to the recognition posture, continue to recognize the machine code and detect whether there is a machine code wooden block with abnormal height. The second time the wooden block with abnormal height is recognized, there is no need to press the space bar to grab it. The terminal will print the clamping information.

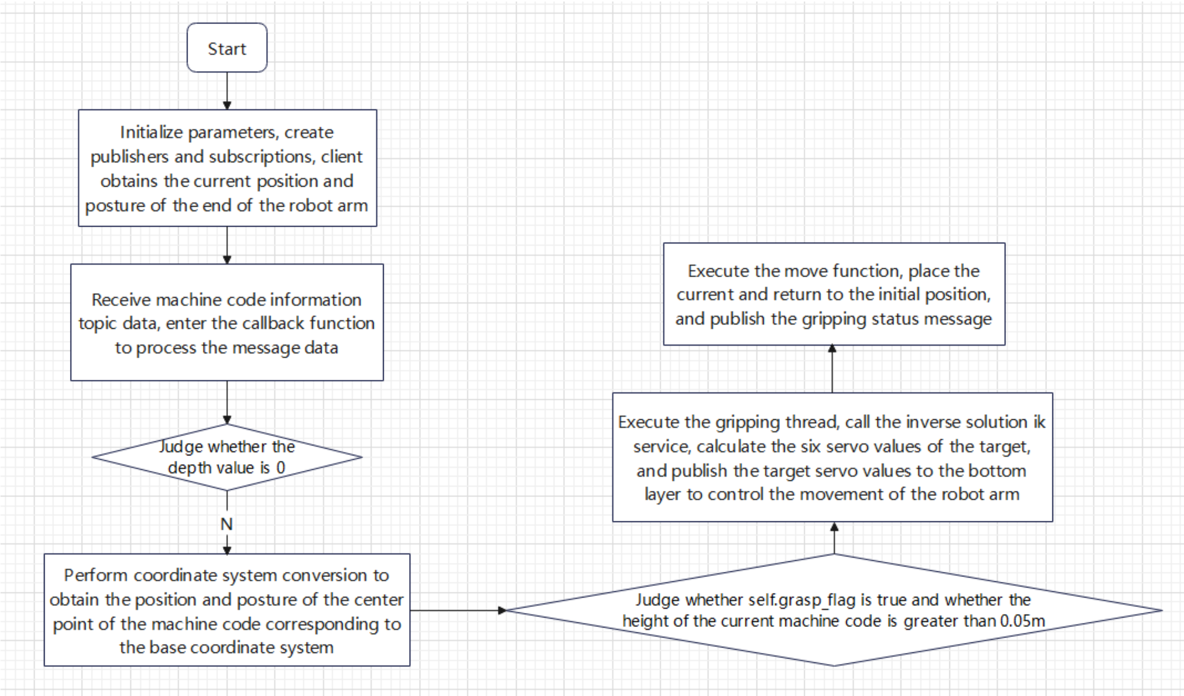
```
jetson@yahboom: ~
y: 0.116261662208
z: 0.0911289015753
Roll: -1.04719753092
Pitch: -0.0
Yaw: 0.0
('pose_T: ', array([ 0.04395173,  0.2140187 ,  0.06098529]))
------------------------------------------------
('pose_T: ', array([ 0.04395173,  0.2140187 ,  0.06098529]))
('calcutelate_request: ', tar_x: 0.0439517272718
tar_y: 0.214018695739
tar_z: 0.0609852858182
Roll: -1.04719753092
Pitch: 0.0
Yaw: 0.0
cur_joint1: 0.0
cur_joint2: 0.0
cur_joint3: 0.0
cur_joint4: 0.0
cur_joint5: 0.0
cur_joint6: 0.0
kin_name: "ik")
('compute_joints: ', [78.24354526247807, 49.65049989634304, 54.79630116898166, 1
5.030021386773575, 90, 30])
```

3. Program flow chart

3.1. apriltag_list.py



3.2. apriltag_remove_higher.py



4. Core code analysis

4.1. apriltag_list.py

Code path:

`/home/jetson/dofbot_pro_ws/src/dofbot_pro_apriltag/scripts/apriltag_list.py`

Import necessary library files

```
import os
import rospy
import numpy as np
```

```
from sensor_msgs.msg import Image
import message_filters
#Import drawing machine code library
from vutils import draw_tags
#Import machine code library
from dt_apriltags import Detector
from cv_bridge import CvBridge
import cv2 as cv
#Import custom service data types
from dofbot_info.srv import kinemarics, kinemaricsRequest, kinemaricsResponse
#Import custom message data types
from dofbot_pro_info.msg import ArmJoint
from dofbot_pro_info.msg import AprilTagInfo
from std_msgs.msg import Float32,Bool
encoding = ['16UC1', '32FC1']
import time
#导入transforms3d 库用于处理三维空间中的变换，执行四元数、旋转矩阵和欧拉角之间的转换，支持三维
几何操作和坐标转换
#Import transforms3d library for processing transformations in three-dimensional
space, performing conversions between quaternions, rotation matrices and Euler
angles, supporting three-dimensional geometric operations and coordinate
conversions
import transforms3d as tfs
#导入transformations处理和计算三维空间中的变换，包括四元数和欧拉角之间的转换
#Import transformations to process and calculate transformations in three-
dimensional space, including conversions between quaternions and Euler angles
import tf.transformations as tf
import math
```

Initialize program parameters, create publishers, subscribers and clients

```
def __init__(self):
    rospy.init_node('apriltag_detect')
    #发布机械臂的初始姿态，同样也是识别的姿态
    #Publish the initial posture of the robot arm, which is also the recognized
posture
    self.init_joints = [90.0, 120, 0, 0.0, 90, 90]
    #创建两个订阅者，订阅彩色图像话题和深度图像话题
    #Create two subscribers to subscribe to the color image topic and the depth
image topic
    self.depth_image_sub =
message_filters.Subscriber('/camera/depth/image_raw',Image)
    self.rgb_image_sub =
message_filters.Subscriber('/camera/color/image_raw',Image)
    #创建发布机器码信息的发布者
    #Create a publisher that publishes machine code information
    self.tag_info_pub = rospy.Publisher("TagInfo",AprilTagInfo,queue_size=1)
    #创建发布机械臂目标角度的发布者
    #Create a publisher that publishes the target angle of the robotic arm
    self.pubPoint = rospy.Publisher("TargetAngle", ArmJoint, queue_size=1)
    #将彩色和深度图像订阅的消息进行时间同步
    #Synchronize the time of color and depth image subscription messages
    self.TimeSynchronizer =
message_filters.ApproximateTimeSynchronizer([self.rgb_image_sub,self.depth_image
_sub],1,0.5)
```

```
    #创建订阅夹取结果的订阅者
    #Create a subscriber to subscribe to the fetch results
    self.grasp_status_sub = rospy.Subscriber('grasp_done', Bool,
self.GraspStatusCallback, queue_size=1)
    #处理同步消息的回调函数TagDetect，回调函数与订阅的消息连接起来，以便在接收到新消息时自动调
用该函数
    #The callback function TagDetect that handles the synchronization message is
connected to the subscribed message so that it can be automatically called when a
new message is received
    self.TimeSynchronizer.registerCallback(self.TagDetect)
    #创建彩色和深度图像话题消息数据转图像数据的桥梁
    #Create a bridge for converting color and depth image topic message data to
image data
    self.rgb_bridge = CvBridge()
    self.depth_bridge = CvBridge()
    #发布机器码信息的标识，为True时发布/TagInfo话题数据
    #The flag for publishing machine code information. When it is True, it will
publish the /TagInfo topic data.
    self.pubPos_flag = False
    #创建机器码的对象，设定一些参数，参数如下，
    #Create a machine code object and set some parameters. The parameters are as
follows:
    '''
    searchpath: specifies the path to search for the tag model.
    families: sets the tag family to be used, for example 'tag36h11'.
    nthreads: the number of threads for parallel processing to increase detection
speed.
    quad_decimate: reduces the resolution of the input image to reduce the amount
of calculation.
    quad_sigma: the standard deviation of the Gaussian blur, which affects image
preprocessing.
    refine_edges: whether to refine the edges to improve detection accuracy.
    decode_sharpening: the sharpening parameter during decoding to enhance the
label contrast.
    debug: the debug mode switch to facilitate viewing of information during the
detection process
    '''
    self.at_detector = Detector(searchpath=['apriltags'],
    families='tag36h11',
    nthreads=8,
    quad_decimate=2.0,
    quad_sigma=0.0,
    refine_edges=1,
    decode_sharpening=0.25,
    debug=0)
    #存放机器码中心x值的列表
    #Store the list of x values of the machine code center
    self.Center_x_list = []
    #存放机器码中心y值的列表
    #Store the list of y values of the machine code center
    self.Center_y_list = []
    self.heigh = 0.0
    #机械臂末端的位置和姿态
    #The position and posture of the end of the robotic arm
    self.CurEndPos = [-0.006,0.116261662208,0.0911289015753,-1.04719,-0.0,0.0]
```

```
    #深度相机内参
    #Depth camera internal parameters
    self.camera_info_K = [477.57421875, 0.0, 319.3820495605469, 0.0,
477.55718994140625, 238.64108276367188, 0.0, 0.0, 1.0]
    #机械臂末端与相机的旋转变换矩阵，描述了两者之间的相对位置和位姿
    #The rotation transformation matrix of the end of the robotic arm and the
camera describes the relative position and posture between the two
    self.EndToCamMat =
np.array([[1.00000000e+00,0.00000000e+00,0.00000000e+00,0.00000000e+00],
    [0.00000000e+00,7.96326711e-04,9.99999683e-01,-9.90000000e-02],
    [0.00000000e+00,-9.99999683e-01,7.96326711e-04,4.90000000e-02],
    [0.00000000e+00,0.00000000e+00,0.00000000e+00,1.00000000e+00]])
    exit_code = os.system('rosservice call /camera/set_color_exposure  50')
```

Machine code information callback function tag_info_callback,

```
def TagDetect(self,color_frame,depth_frame):
    #rgb_image
    rgb_image = self.rgb_bridge.imgmsg_to_cv2(color_frame,'rgb8')
    result_image = np.copy(rgb_image)
    #depth_image
    depth_image = self.depth_bridge.imgmsg_to_cv2(depth_frame, encoding[1])
    frame = cv.resize(depth_image, (640, 480))
    depth_image_info = frame.astype(np.float32)
    tags = self.at_detector.detect(cv2.cvtColor(rgb_image, cv2.COLOR_RGB2GRAY),
False, None, 0.025)
    tags = sorted(tags, key=lambda tag: tag.tag_id) # 貌似出来就是升序排列的不需要手动
进行排列  It seems that the output is in ascending order and does not need to be
sorted manually
    draw_tags(result_image, tags, corners_color=(0, 0, 255), center_color=(0,
255, 0))
    key = cv2.waitKey(10)
    self.Center_x_list = list(range(len(tags)))
    self.Center_y_list = list(range(len(tags)))
    if key == 32:
        self.pubPos_flag = True
    if len(tags) > 0 :
        for i in range(len(tags)):
            center_x, center_y = tags[i].center
            #机器码的中心xy值存在Center_x_list列表和Center_y_list列表中
            #The center xy values ••of the machine code are stored in the
Center_x_list list and the Center_y_list list
            self.Center_x_list[i] = center_x
            self.Center_y_list[i] = center_y
            cx = center_x
            cy = center_y
            #计算中心坐标的深度值
            #Calculate the depth value of the center coordinate
            cz = depth_image_info[int(cy),int(cx)]/1000
            #调用compute函数，计算机器码的高度，传入的参数是机器码的中心坐标和中心点的深度
值，返回的是一个位置列表，pose[2]表示z值，也就是高度值
            #Call the compute function to calculate the height of the machine
code. The parameters passed in are the center coordinates of the machine code and
the depth value of the center point. The returned value is a position list.
pose[2] represents the z value, which is the height value.
```

```
            pose = self.compute_heigh(cx,cy,cz)
            #对高度值进行放大运算，把单位换算成毫米
            #Enlarge the height value and convert the unit into millimeters
            heigh = round(pose[2],4)*1000
            heigh = 'heigh: ' + str(heigh) + 'mm'
            #计算机器码离基坐标系的距离值，对该值进行放大运算，把单位换算成毫米
            #Calculate the distance between the machine code and the base coordinate system, enlarge the value, and convert the unit into millimeters
            dist_detect = math.sqrt(pose[1] ** 2 + pose[0]** 2)
            dist_detect = round(dist_detect,3)*1000
            dist = 'dist: ' + str(dist_detect) + 'mm'
            #高度和距离值使用opencv绘制在彩色图像上
            #Height and distance values ••are drawn on the color image using opencv
            cv.putText(result_image, heigh, (int(cx)+5, int(cy)-15), cv.FONT_HERSHEY_SIMPLEX, 0.5, (255, 0, 0), 2)
            cv.putText(result_image, dist, (int(cx)+5, int(cy)+15), cv.FONT_HERSHEY_SIMPLEX, 0.5, (255, 0, 0), 2)
            print("Pose: ",pose)
        for i in range(len(tags)):
            if self.pubPos_flag == True:
                tag = AprilTagInfo()
                #给消息数据赋值，id值为机器码的id，x和y为机器码的中心值，z为中心点的深度值，这里做了按比例缩小1000倍数，单位是米
                #Assign values to the message data. The id value is the id of the machine code. x and y are the center values ••of the machine code. z is the depth value of the center point. Here, it is scaled down by 1000 times. The unit is meter.
                tag.id = tags[i].tag_id
                tag.x = self.Center_x_list[i]
                tag.y = self.Center_y_list[i]
                tag.z = depth_image_info[int(tag.y),int(tag.x)]/1000
                #判断如果机器码的距离不等于0，说明为有效数据，然后发布机器码信息的消息
                #If the distance of the machine code is not equal to 0, it means it is valid data, and then publish the message of the machine code information
                if tag.z!=0:
                    self.tag_info_pub.publish(tag)
                #改变self.pubPos_flag状态，防止多次发布信息，等待夹取完成后再改变状态
                #Change the state of self.pubPos_flag to prevent multiple publishing of information, and wait until the clamping is completed before changing the state
                    self.pubPos_flag = False
                else:
                    print("Invalid distance.")
    #转换彩色图的颜色空间，把RGB转换成BGR
    #Convert the color space of the color image, convert RGB to BGR
    result_image = cv2.cvtColor(result_image, cv2.COLOR_RGB2BGR)
    #显示图像 Display the image
    cv2.imshow("result_image", result_image)
    key = cv2.waitKey(1)
```

Calculate the height value function compute_heigh

```
def compute_heigh(self,x,y,z):
    #第一次坐标系转换，由像素坐标系转换到相机坐标系下
```

```
    #The first coordinate system conversion, from the pixel coordinate system to the camera coordinate system
    camera_location = self.pixel_to_camera_depth((x,y),z)
    #print("camera_location: ",camera_location)
    #第二次坐标系转换，由相机坐标系转换到机械臂末端的坐标系下#The second coordinate system conversion, from the camera coordinate system to the coordinate system of the end of the robotic arm
    PoseEndMat = np.matmul(self.EndToCamMat, self.xyz_euler_to_mat(camera_location, (0, 0, 0)))
    #PoseEndMat = np.matmul(self.xyz_euler_to_mat(camera_location, (0, 0, 0)),self.EndToCamMat)
    #获取当前的机械臂末端位置和位姿
    #Get the current end position and posture of the robot arm
    EndPointMat = self.get_end_point_mat()
    #第三次坐标系转换，由机械臂末端的坐标系转换到基座标系下，得到的worldPose（旋转变换矩阵）就是机器码的中心相对应机械臂基座标系的位置和姿态
    #The third coordinate system conversion is to convert the coordinate system of the end of the robot arm to the base coordinate system. The obtained worldPose (rotation transformation matrix) is the position and posture of the center of the machine code corresponding to the base coordinate system of the robot arm.
    WorldPose = np.matmul(EndPointMat, PoseEndMat)
    #WorldPose = np.matmul(PoseEndMat,EndPointMat)
    #把旋转变换矩阵转换成xyz和欧拉角
    #Convert the rotation transformation matrix into xyz and Euler angles
    pose_T, pose_R = self.mat_to_xyz_euler(WorldPose)
    #返回表示位置的pose_T
    #Return pose_T representing the position
    return pose_T
```

4.2、apriltag_remove_higher.py

Code path:

`/home/jetson/dofbot_pro_ws/src/dofbot_pro_apriltag/scripts/apriltag_remove_higher.py`

Import necessary library files

```
import math
import rospy
import numpy as np
from std_msgs.msg import Float32,Bool
import time
from dofbot_pro_info.msg import *
from dofbot_pro_info.srv import *
#导入transforms3d 库用于处理三维空间中的变换，执行四元数、旋转矩阵和欧拉角之间的转换，支持三维几何操作和坐标转换
#Import the transforms3d library to handle transformations in three-dimensional space, perform conversions between quaternions, rotation matrices, and Euler angles, and support three-dimensional geometric operations and coordinate conversions
import transforms3d as tfs
#导入transformations处理和计算三维空间中的变换，包括四元数和欧拉角之间的转换
#Import transformations to process and calculate transformations in three-dimensional space, including conversions between quaternions and Euler angles
import tf.transformations as tf
```

```
import threading
```

Initialize program parameters, create publishers, subscribers, and clients

```
def __init__(self):
    nodeName = 'Apriltag_remove_heigher'
    rospy.init_node(nodeName)
    #创建订阅TagInfo话题的订阅者，订阅机器码信息的消息
    #Create a subscriber to subscribe to the TagInfo topic and subscribe to
messages about machine code information
    self.tag_info_sub = rospy.Subscriber("TagInfo", AprilTagInfo,
self.tag_info_callback, queue_size=1)
    #创建发布舵机目标角度的话题的发布者，发布控制机械臂舵机的消息
    #Create a publisher for the topic of the target angle of the servo, and
publish messages to control the robotic arm servo
    self.pubPoint = rospy.Publisher("TargetAngle", ArmJoint, queue_size=1)
    #创建发布夹取结果的话题的发布者，发布夹取结果的消息
    #Create a publisher for the topic of clamping results and publish the message
of clamping results
    self.pubGraspStatus = rospy.Publisher("grasp_done", Bool, queue_size=1)
    #创建请求逆解算服务的客户端，用于计算当前机械臂末端位置和位姿以及解算目标的舵机值
    #Create a client requesting the inverse solution service to calculate the
current end position and posture of the robotic arm and the servo value of the
solution target
    self.client = rospy.ServiceProxy("get_kinemarics", kinemarics)
    #初始夹取的标识，True为可夹取，False为不可夹取
    #Initial gripping flag, True means grippable, False means not grippable
    self.grasp_flag = True
    self.init_joints = [90.0, 120, 0.0, 0.0, 90, 90]
    self.down_joint = [130.0, 55.0, 34.0, 16.0, 90.0,125]
    self.gripper_joint = 90
    #初始化当前位置位姿，对应的是x、y、z、roll、pitch和yaw
    #Initialize the current position and posture, corresponding to x, y, z, roll,
pitch and yaw
    self.CurEndPos = [0.0, 0.0, 0.0, 0.0, 0.0, 0.0]
    #深度相机的内参  Internal parameters of the depth camera
    self.camera_info_K = [477.57421875, 0.0, 319.3820495605469, 0.0,
477.55718994140625, 238.64108276367188, 0.0, 0.0, 1.0]
    #机械臂末端与相机的旋转变换矩阵，描述了两者之间的相对位置和位姿
    #The rotation transformation matrix of the end of the robotic arm and the
camera describes the relative position and posture between the two
    self.EndToCamMat =
np.array([[1.00000000e+00,0.00000000e+00,0.00000000e+00,0.00000000e+00],
                                 [0.00000000e+00,7.96326711e-04,9.99999683e-
01,-9.90000000e-02],
                                 [0.00000000e+00,-9.99999683e-01,7.96326711e-
04,4.90000000e-02],

[0.00000000e+00,0.00000000e+00,0.00000000e+00,1.00000000e+00]])
    #获取当前的机械臂末端的位置和位姿，会改变self.CurEndPos的值
    #Get the current position and posture of the end of the robot arm, which will
change the value of self.CurEndPos
    self.get_current_end_pos()
    #定义当前的id值，后边根据该值把机器码放置在对应的位置
```

```
    #Define the current id value, and then place the machine code in the corresponding position according to the value
    self.cur_tagId = 0
    #打印当前机械臂末端的位置位姿
    #Print the current position and posture of the end of the robot arm
    print("Current_End_Pose: ",self.CurEndPos)
    print("Init Done")
```

Machine code information callback function tag_info_callback,

```
def tag_info_callback(self,msg):
    #print("msg: ",msg)
    pos_x = msg.x
    pos_y = msg.y
    pos_z = msg.z
    self.cur_tagId = msg.id
    #判断如果接收到的中心点的深度信息不为>0,说明为有效数据
    # If the received center point depth information is not > 0, it means it is valid data
    if pos_z!=0.0:
        print("xyz id : ",pos_x,pos_y,pos_z,self.cur_tagId)
        #获取当前的机械臂末端位置和位姿
        #Get the current end position and posture of the robot arm
        self.get_current_end_pos()
        #第一次坐标系转换，由像素坐标系转换到相机坐标系下
        #The first coordinate system conversion, from the pixel coordinate system to the camera coordinate system
        camera_location = self.pixel_to_camera_depth((pos_x,pos_y),pos_z)
        #print("camera_location: ",camera_location)
        #第二次坐标系转换，由相机坐标系转换到机械臂末端的坐标系下
        #The second coordinate system conversion, from the camera coordinate system to the coordinate system of the end of the robotic arm
        PoseEndMat = np.matmul(self.EndToCamMat, self.xyz_euler_to_mat(camera_location, (0, 0, 0)))
        EndPointMat = self.get_end_point_mat()
        #第三次坐标系转换，由机械臂末端的坐标系转换到基座标系下，得到的worldPose（旋转变换矩阵）就是机器码的中心相对应机械臂基座标系的位置和姿态
        #The third coordinate system conversion is to convert the coordinate system of the end of the robot arm to the base coordinate system. The obtained worldPose (rotation transformation matrix) is the position and posture of the center of the machine code corresponding to the base coordinate system of the robot arm.
        WorldPose = np.matmul(EndPointMat, PoseEndMat)
        #把旋转变换矩阵转换成xyz和欧拉角
        #Convert the rotation transformation matrix into xyz and Euler angles
        pose_T, pose_R = self.mat_to_xyz_euler(WorldPose)
        print("pose_T: ",pose_T)
        #判断夹取的标识，为True且高度大于0.05时，也就是高于0.05m时候，执行下爪夹取
        #Judge the gripping flag. When it is True and the height is greater than 0.05, that is, higher than 0.05m, the lower claw gripping is executed.
        if self.grasp_flag == True and (pose_T[2])>0.05:
            self.grasp_flag = False
            #开启一个线程，线程执行grasp的程序，参数是刚才计算的到的pose_T,也就是xyz的值，表示机械臂末端的目标位置
```

```
            #Start a thread, the thread executes the grasp program, the parameter is the pose_T just calculated, that is, the value of xyz, indicating the target position of the end of the robot arm
            grasp = threading.Thread(target=self.grasp, args=(pose_T,))
            grasp.start()
            grasp.join()
```

The function grasp of the robot arm's lower claw

```
def grasp(self,pose_T):
    print("------------------------------------------------")
    print("pose_T: ",pose_T)
    #调用逆解算的服务，调用的是ik服务内容，把需要的request参数赋值进去
    #Call the inverse solution service, call the ik service content, and assign the required request parameters
    request = kinemaricsRequest()
    #机械臂末端的目标x值，单位是m，0.01是x轴方向（左右）偏移量参数，由于舵机的微小差异性，无法保证计算出来的位置于实际的一样，根据实际情况进行微小的调整
    #The target x value at the end of the robot arm, in meters, 0.01 is the offset parameter in the x-axis direction (left and right). Due to the slight differences in the servos, it is impossible to guarantee that the calculated position is the same as the actual one. Make slight adjustments based on the actual situation.
    request.tar_x = pose_T[0]  - 0.01
    #机械臂末端的目标y值，单位是m，0.015是y轴方向（前后）偏移量参数，由于舵机的微小差异性，无法保证计算出来的位置于实际的一样，根据实际情况进行微小的调整
    #The target y value at the end of the robot arm, in meters. 0.015 is the offset parameter in the y-axis direction (front and back). Due to the slight differences in the servos, it is impossible to guarantee that the calculated position is the same as the actual one. Make slight adjustments based on the actual situation.
    request.tar_y = pose_T[1]  + 0.015
    #机械臂末端的目标z值，单位是m，0.02是z轴方向（高低）偏移量参数由于舵机的微小差异性，无法保证计算出来的位置于实际的一样，根据实际情况进行微小的调整
    #The target z value at the end of the robot arm, in meters, 0.02 is the offset parameter in the z-axis direction (high and low). Due to the slight differences in the servos, it is impossible to guarantee that the calculated position is the same as the actual one. Make slight adjustments based on the actual situation.
    request.tar_z = pose_T[2] + request.tar_y* 0.02
    #指定服务的内容为ik
    #Specify the service content as ik
    request.kin_name = "ik"
    #机械臂末端的目标Roll值，单位是弧度，该值为当前的机械臂末端的roll值
    #The target Roll value at the end of the robot arm, in radians, is the current roll value at the end of the robot arm
    request.Roll = self.CurEndPos[3]
    print("calcutelate_request: ",request)
    try:
        response = self.client.call(request)
        #print("calcutelate_response: ",response)
        joints = [0.0, 0.0, 0.0, 0.0, 0.0,0.0]
        #调用服务返回的joint1-joint6值赋值给joints
        #Assign the joint1-joint6 values ••returned by the call service to joints
```

```
        joints[0] = response.joint1 #response.joint1
        joints[1] = response.joint2
        joints[2] = response.joint3
        if response.joint4>90:
            joints[3] = 90
        else:
            joints[3] = response.joint4
        joints[4] = 90
        joints[5] = 30
        print("compute_joints: ",joints)
        #执行pubTargetArm函数，把计算得到的joints值作为参数传入
        #Execute the pubTargetArm function and pass the calculated joints value
as a parameter
        self.pubTargetArm(joints)
        time.sleep(3.5)
        #执行move函数，夹取木块根据机器码的id值放置在设定的位置
        #Execute the move function, grab the block and place it at the set
position according to the machine code ID value
        self.move()
    except Exception:
       rospy.loginfo("run error")
```

Publish the robot arm target angle function pubTargetArm

```
def pubArm(self, joints, id=1, angle=90, run_time=2000):
    armjoint = ArmJoint()
    armjoint.run_time = run_time
    if len(joints) != 0: armjoint.joints = joints
    else:
        armjoint.id = id
        armjoint.angle = angle
        self.pubPoint.publish(armjoint)
```

Grab and place function move

```
def move(self):
    print("self.gripper_joint = ",self.gripper_joint)
    self.pubArm([],5, self.gripper_joint, 2000)
    time.sleep(2.5)
    self.pubArm([],6, 135, 2000)
    time.sleep(2.5)
    self.pubArm([],2, 135, 2000)
    time.sleep(2.5)
    #根据id值，改变self.down_joint的值，该值表示机器码木块放置的位置
    #According to the id value, change the value of self.down_joint, which
indicates the position of the machine code block.
    if self.cur_tagId == 1:
        self.down_joint = [130.0, 55.0, 34.0, 16.0, 90.0,135]
    elif self.cur_tagId == 2:
        self.down_joint = [170.0, 55.0, 34.0, 16.0, 90.0,135]
    elif self.cur_tagId == 3:
        self.down_joint = [50.0, 55.0, 34.0, 16.0, 90.0,135]
    elif self.cur_tagId == 4:
```

```
        self.down_joint = [10.0, 55.0, 34.0, 16.0, 90.0,135]
    self.pubArm(self.down_joint)
    time.sleep(2.5)
    self.pubArm([],6, 90, 2000)
    time.sleep(2.5)
    self.pubArm([],2, 90, 2000)
    time.sleep(2.5)
    #放置完成后，回到初始位置
    #After placement is completed, return to the initial position
    self.pubArm(self.init_joints)
    time.sleep(5)
    #等待机械臂回到初始位置后，发布抓取完成的消息，改变抓取的标识值以便于下一次符合条件后下爪夹取
    #After waiting for the robot arm to return to the initial position, publish the message that the grasping is completed, and change the grasping identification value so that the next time the conditions are met, the lower claw will grasp
    self.grasp_flag = True
    grasp_done = Bool()
    grasp_done.data = True
    self.pubGraspStatus.publish(grasp_done)
```