Robotiks WS17/17

Assignment 3

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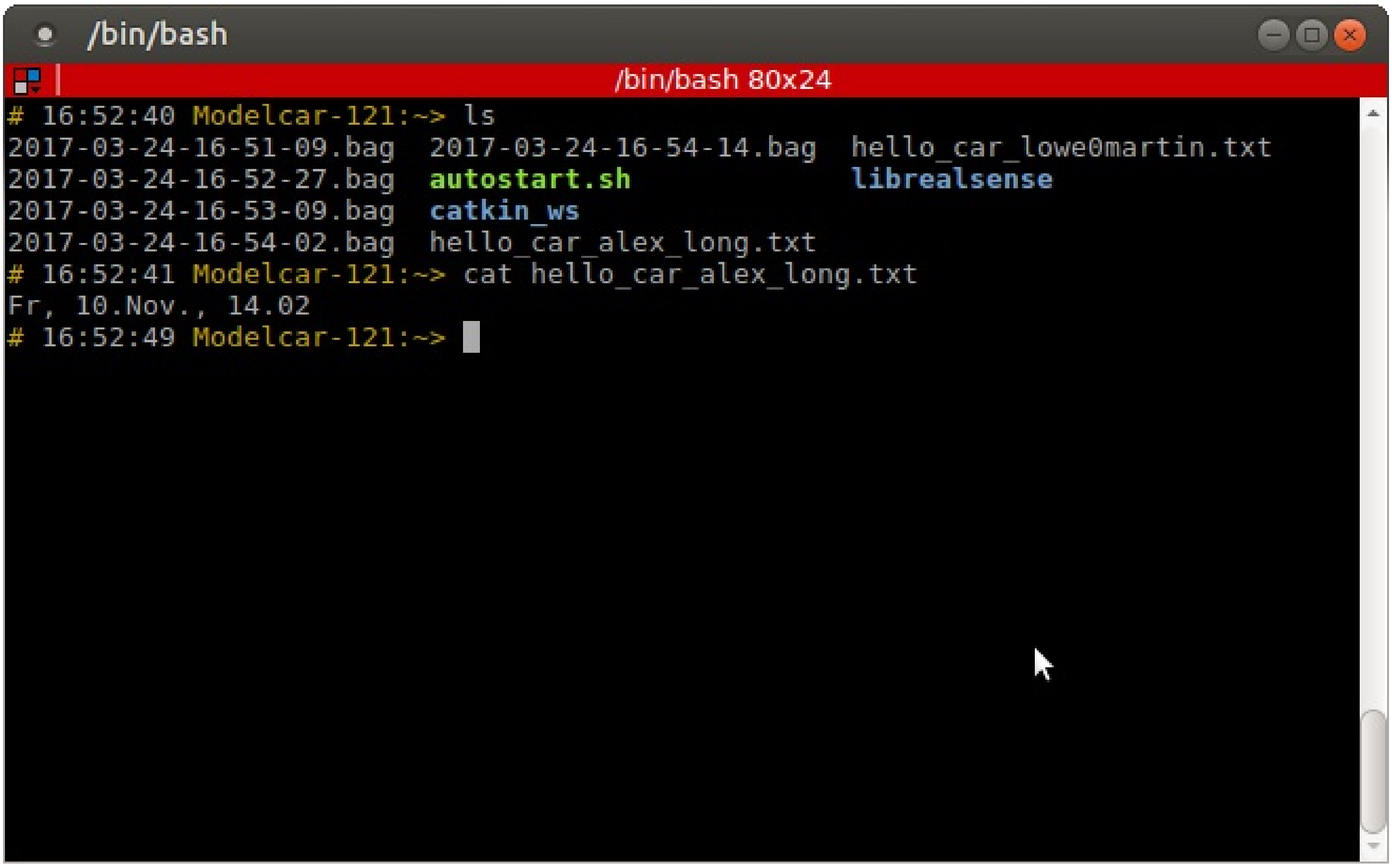
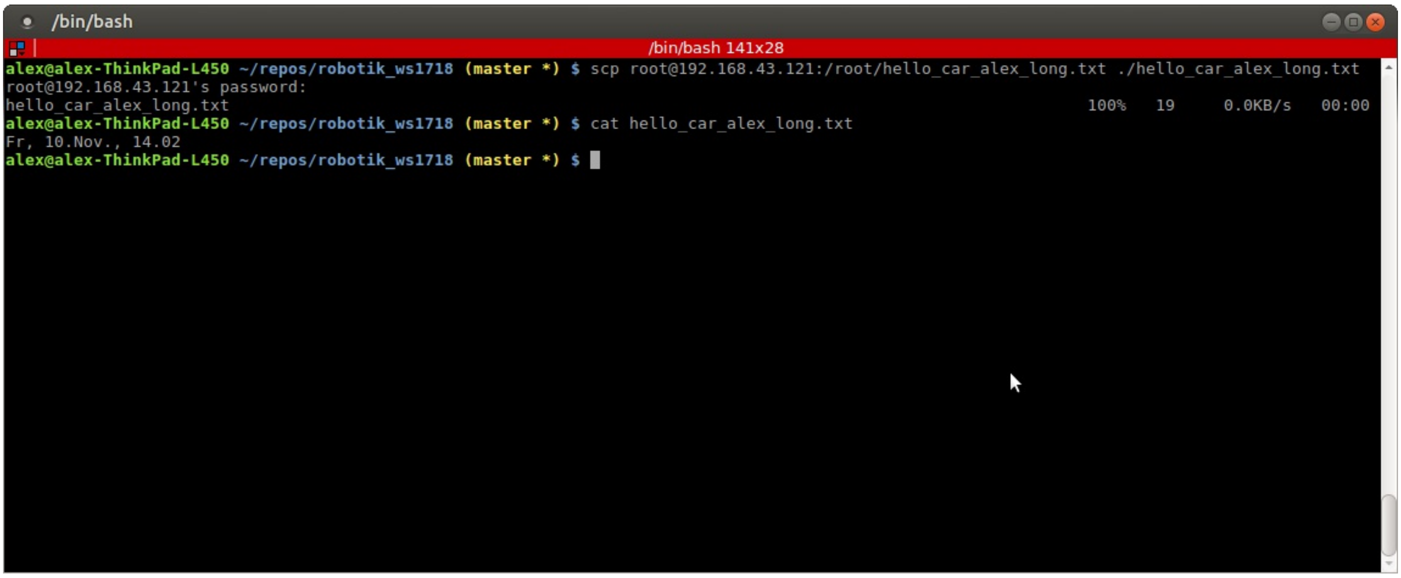
Connect to the model car via SSH

We created a file `hello_car_alex_long.txt` with current time and date `Fr, 10.Nov, 14.02`:



```
# 16:52:40 Modelcar-121:~> ls
2017-03-24-16-51-09.bag  2017-03-24-16-54-14.bag  hello_car_lowe0martin.txt
2017-03-24-16-52-27.bag  autostart.sh             librealsense
2017-03-24-16-53-09.bag  catkin_ws
2017-03-24-16-54-02.bag  hello_car_alex_long.txt
# 16:52:41 Modelcar-121:~> cat hello_car_alex_long.txt
Fr, 10.Nov., 14.02
# 16:52:49 Modelcar-121:~> 
```



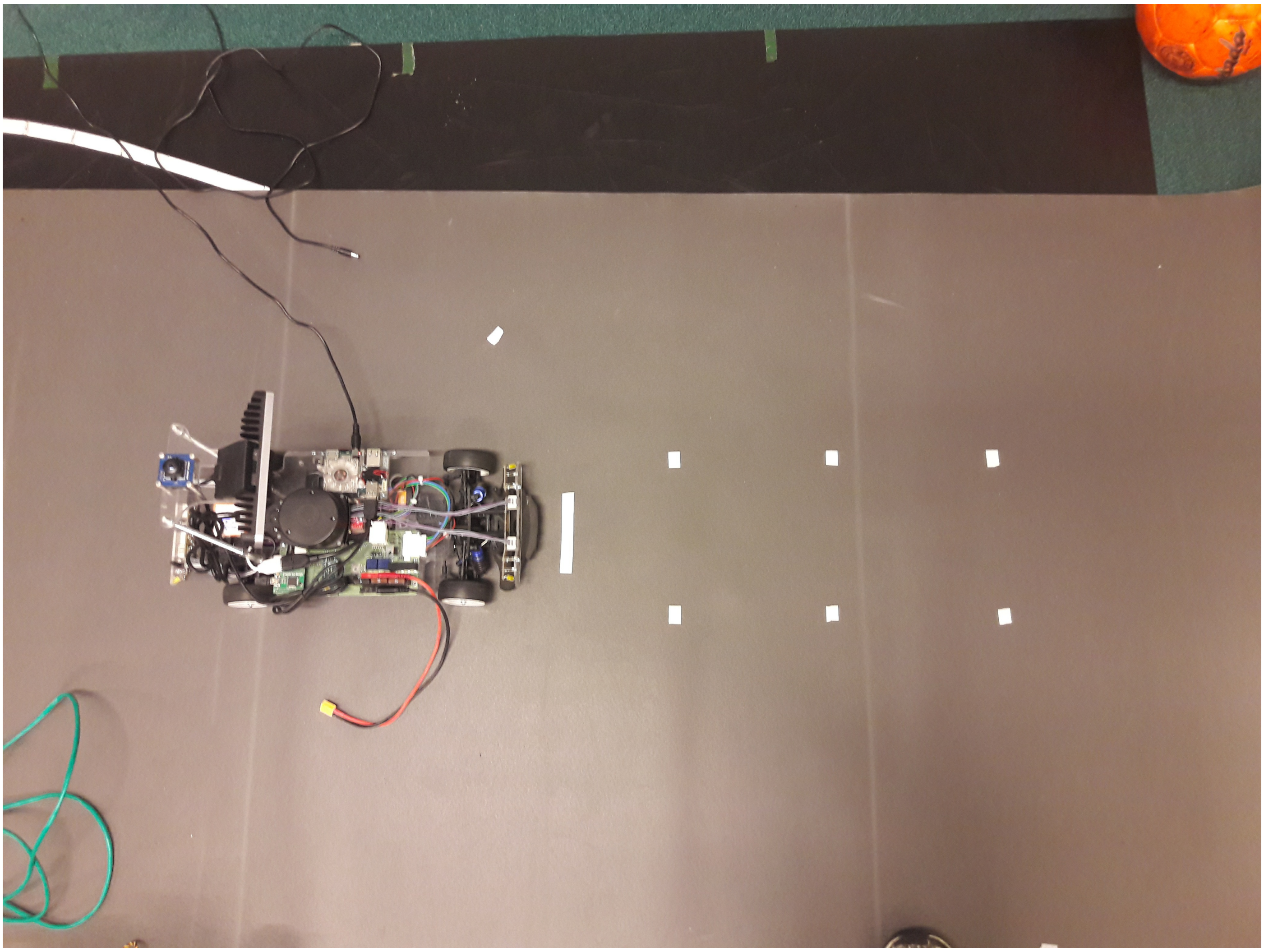
```
alex@alex-ThinkPad-L450 ~/repos/robotik_ws1718 (master *) $ scp root@192.168.43.121:/root/hello_car_alex_long.txt ./hello_car_alex_long.txt
root@192.168.43.121's password:
hello_car_alex_long.txt                                                                                    100%   19     0.0KB/s   00:00
alex@alex-ThinkPad-L450 ~/repos/robotik_ws1718 (master *) $ cat hello_car_alex_long.txt
Fr, 10.Nov., 14.02
alex@alex-ThinkPad-L450 ~/repos/robotik_ws1718 (master *) $ 
```

Create a repository

We forked the project on github:

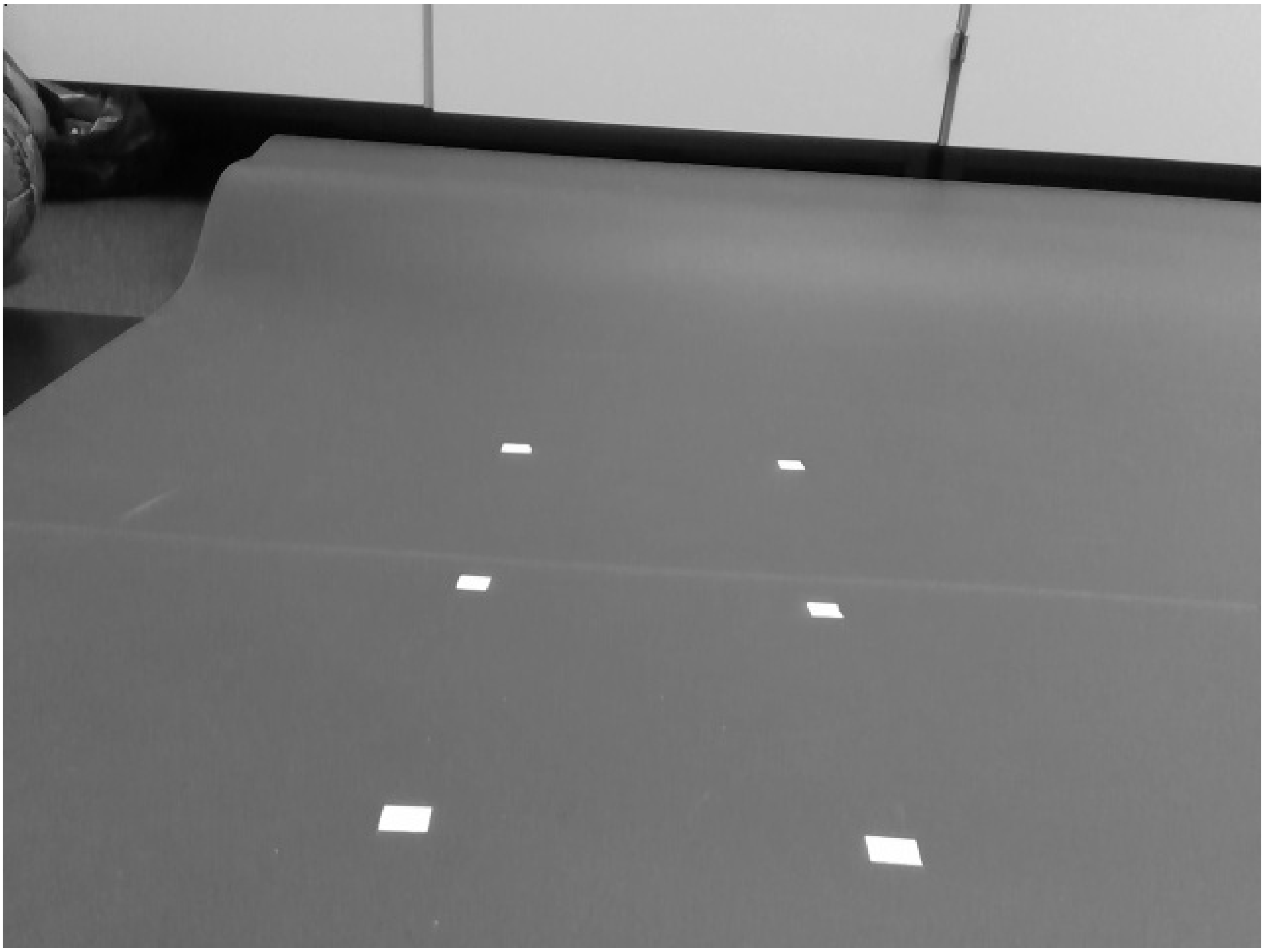
https://github.com/al-eax/catkin_ws_user

Prepare the field



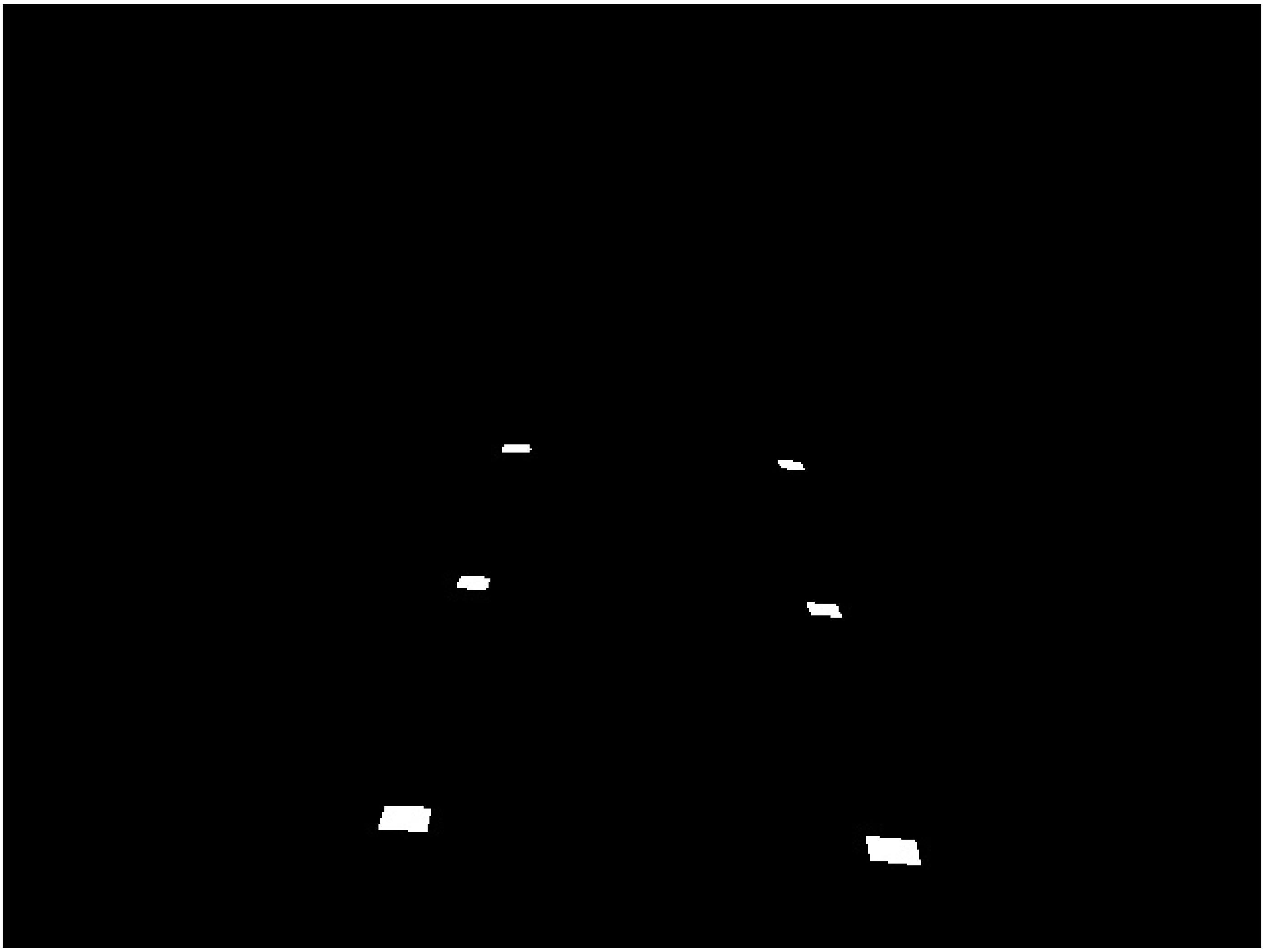
Monochrome (grayscale) image

```
def cameraRawCallback(data):
                global cv_input_image
                global bridge
                cv_input_image = bridge.imgmsg_to_cv2(data, "bgr8")
                #...
                cv_gray_image = cv2.cvtColor(cv_input_image, cv2.COLOR_BGR2GRAY)
                #...
                cv2.imwrite("cam_image_gray.png",cv_gray_image)
```



Black and white image

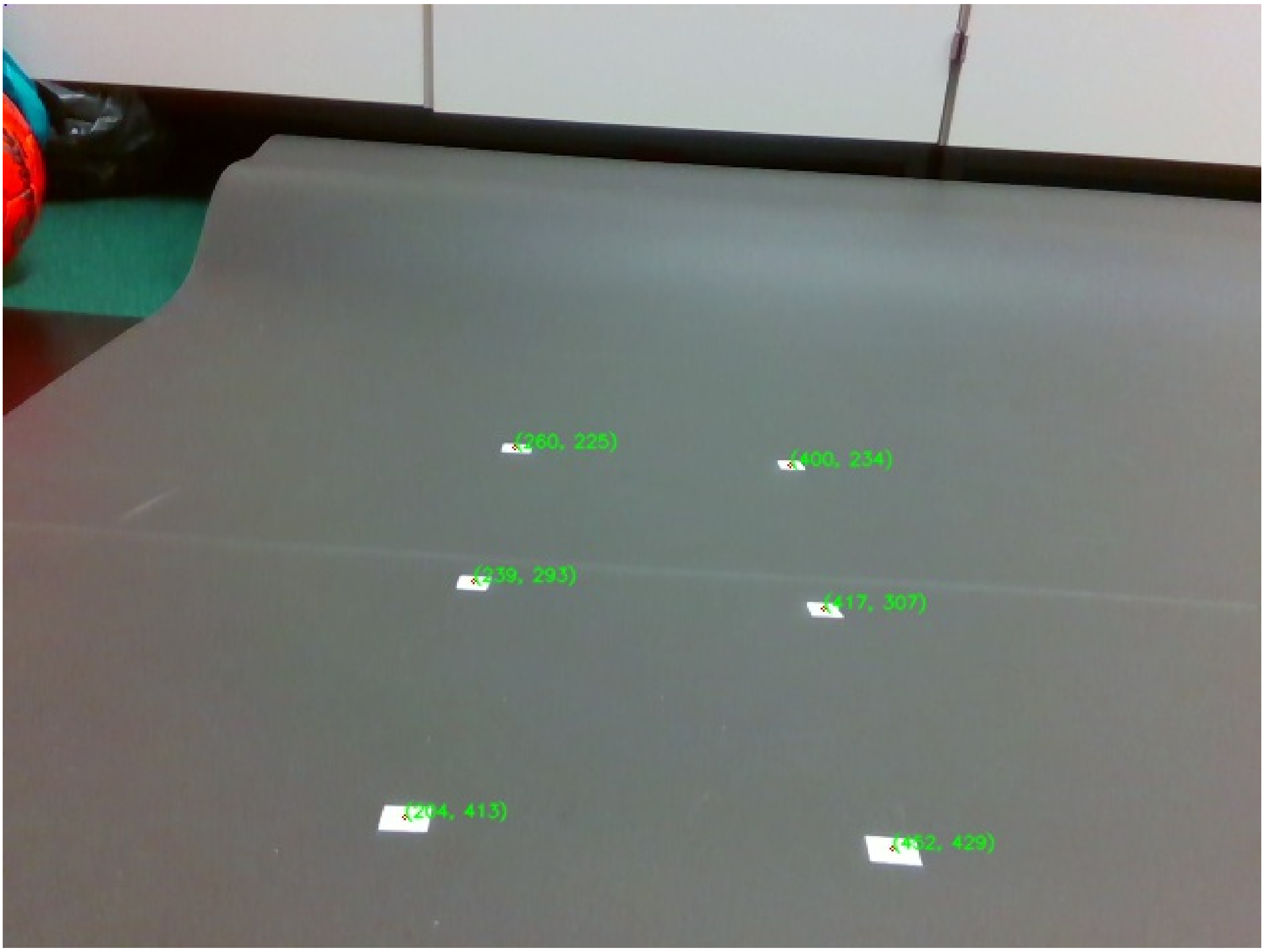
```
_, cv_binary_image = cv2.threshold(cv_gray_image,220,255,cv2.THRESH_BINARY)
#...
def pubImages(img_gray, img_bin):
    global bridge
    gray_scale_pub = rospy.Publisher("/gray_scale_img",Image,queue_size = 10)
    bin_pub = rospy.Publisher("/binary_img",Image,queue_size = 10)

    ros_image_gray = bridge.cv2_to_imgmsg(img_gray, "mono8") #mono8 1 channel = grayscale
    ros_image_bin = bridge.cv2_to_imgmsg(img_bin, "mono8")

    gray_scale_pub.publish(ros_image_gray)
    bin_pub.publish(ros_image_bin)
```



find the white points in the image

We used OpenCVs `findContours` function and image moments to calculate the centers:

```
def getPoints(bin_image):
                image, contours, hierarchy = cv2.findContours(bin_image,1, 2)
                #...
                points = []
                for contour in contours:
                                M = cv2.moments(contour)
                                #...
                                if M['m00'] != 0:
                                                cx = int(M['m10']/M['m00'])
                                                cy = int(M['m01']/M['m00'])
                                                points.append((cx,cy))
```

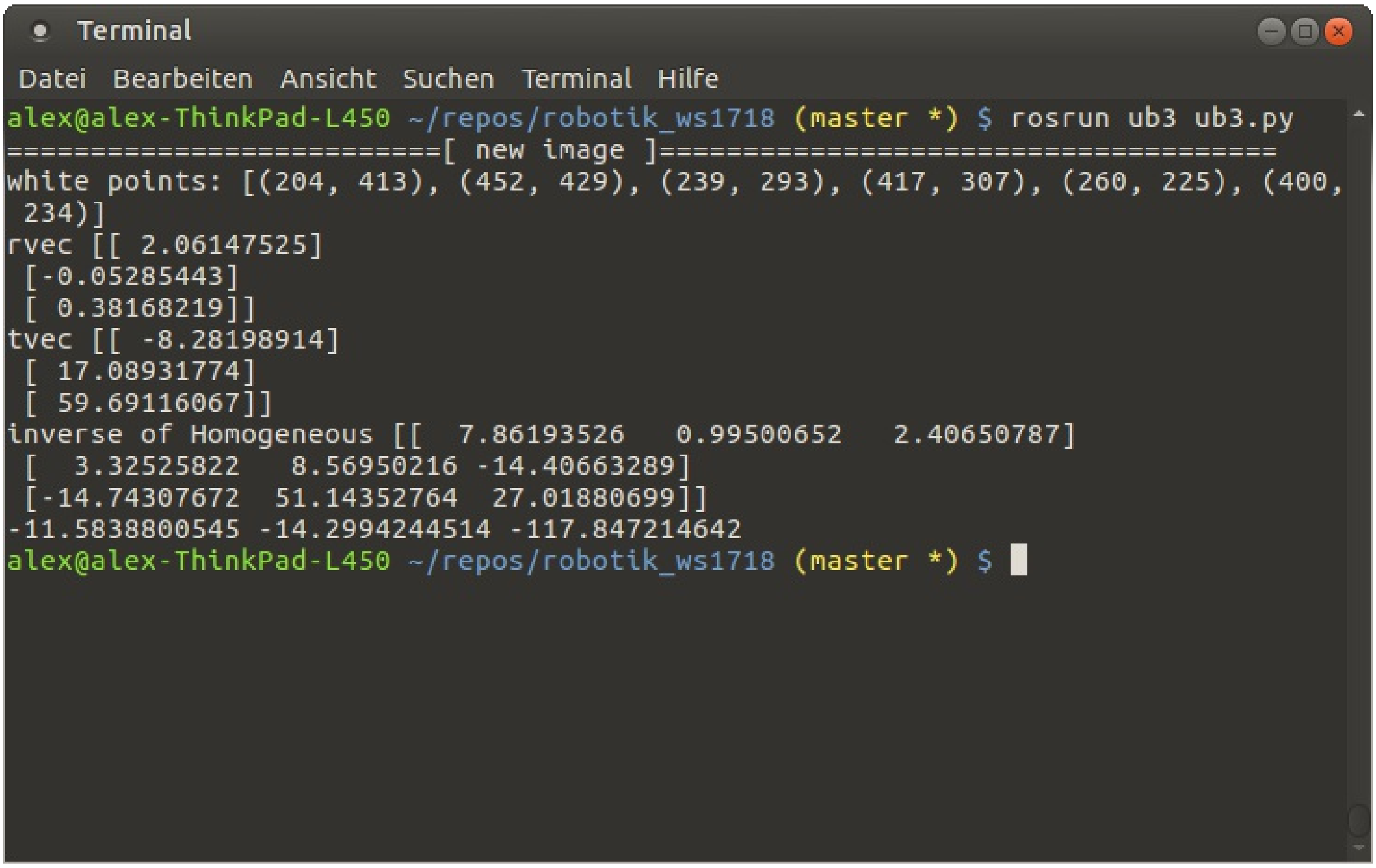


Compute the extrinsic parameters

```
model_points = np.array([(0,0,0), (20,0,0), (0,20,0),

(20,20,0), (0,40,0) , (40,40,0)],

dtype = "double")
#...
camera_matrix = np.matrix( [[fx,0,cx],

[0,fy,cy],

[0,0,1]], dtype = "double")

distortion_params = np.array([[k1],[k2],[t1],[t2]], dtype = "double")

points = getPoints(cv_bin_image)
image_points = np.array(points,  dtype = "double")
(_, rvec, tvec) =
cv2.solvePnP(model_points,image_points,camera_matrix,distortion_params)
```

We printed:

1. the 2d image coordinates
2. the rotation vector
3. the translation vector
4. the inverse of homogeneous
5. pitch, yaw and roll in deg



```
alex@alex-ThinkPad-L450 ~/repos/robotik_ws1718 (master *) $ rosrun ub3 ub3.py
==========================[ new image ]=====================================
white points: [(204, 413), (452, 429), (239, 293), (417, 307), (260, 225), (400,
 234)]
rvec [[ 2.06147525]
 [-0.05285443]
 [ 0.38168219]]
tvec [[ -8.28198914]
 [ 17.08931774]
 [ 59.69116067]]
inverse of Homogeneous [[  7.86193526   0.99500652   2.40650787]
 [  3.32525822   8.56950216 -14.40663289]
 [-14.74307672  51.14352764  27.01880699]]
-11.5838800545 -14.2994244514 -117.847214642
alex@alex-ThinkPad-L450 ~/repos/robotik_ws1718 (master *) $
```

Finding the camera location and orientation

we mostly translated the cpp code:

```
#...
rotM,_ = cv2.Rodrigues(rvec)

inv_rmat = rotM.T
inv_tvec = -inv_rmat * tvec

yaw = math.atan2(inv_rmat[1][0] ,inv_rmat[0][0])
pitch = math.atan2(-inv_rmat[2][0], math.sqrt(inv_rmat[2][1]**2 + inv_rmat[2][2]**2))
roll = math.atan2(inv_rmat[2][1], inv_rmat[2][2])
```

Unfortunately we are not sure, if our calculations are correct. The translation and the view angles make no sense.