

Introduction to Robotics for cognitive science

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Web page of the subject

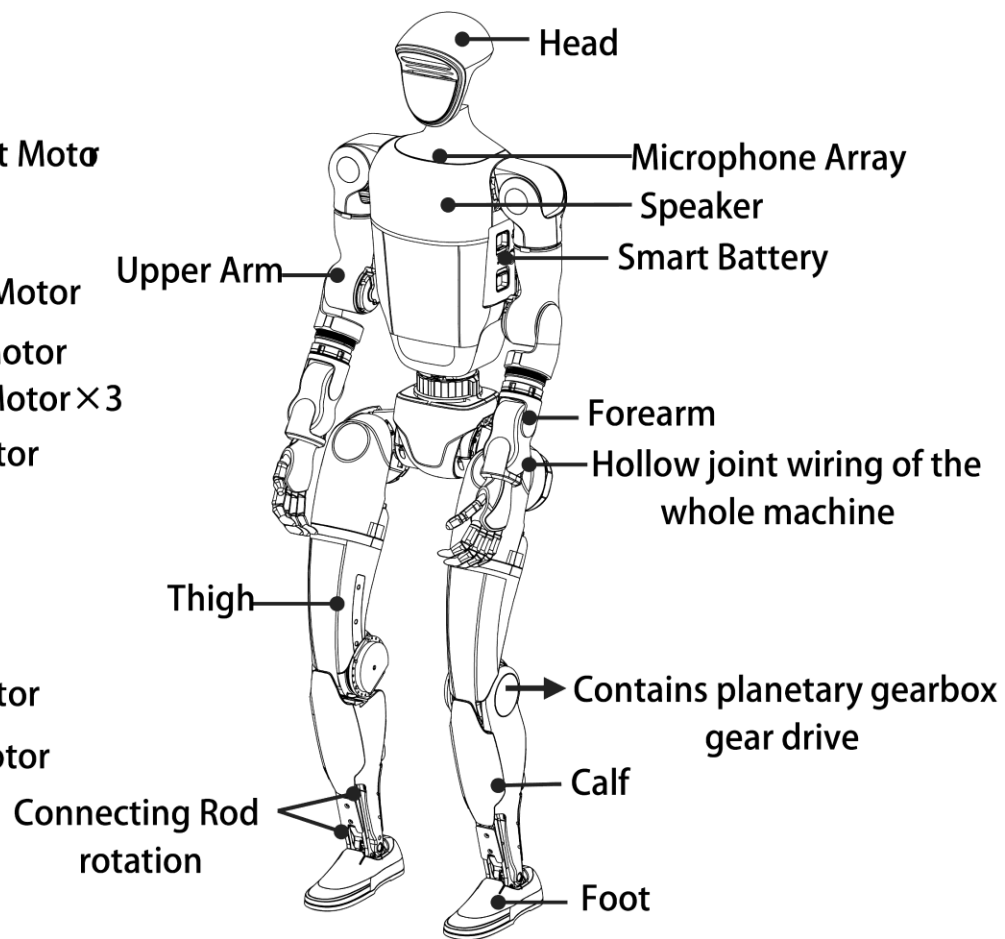
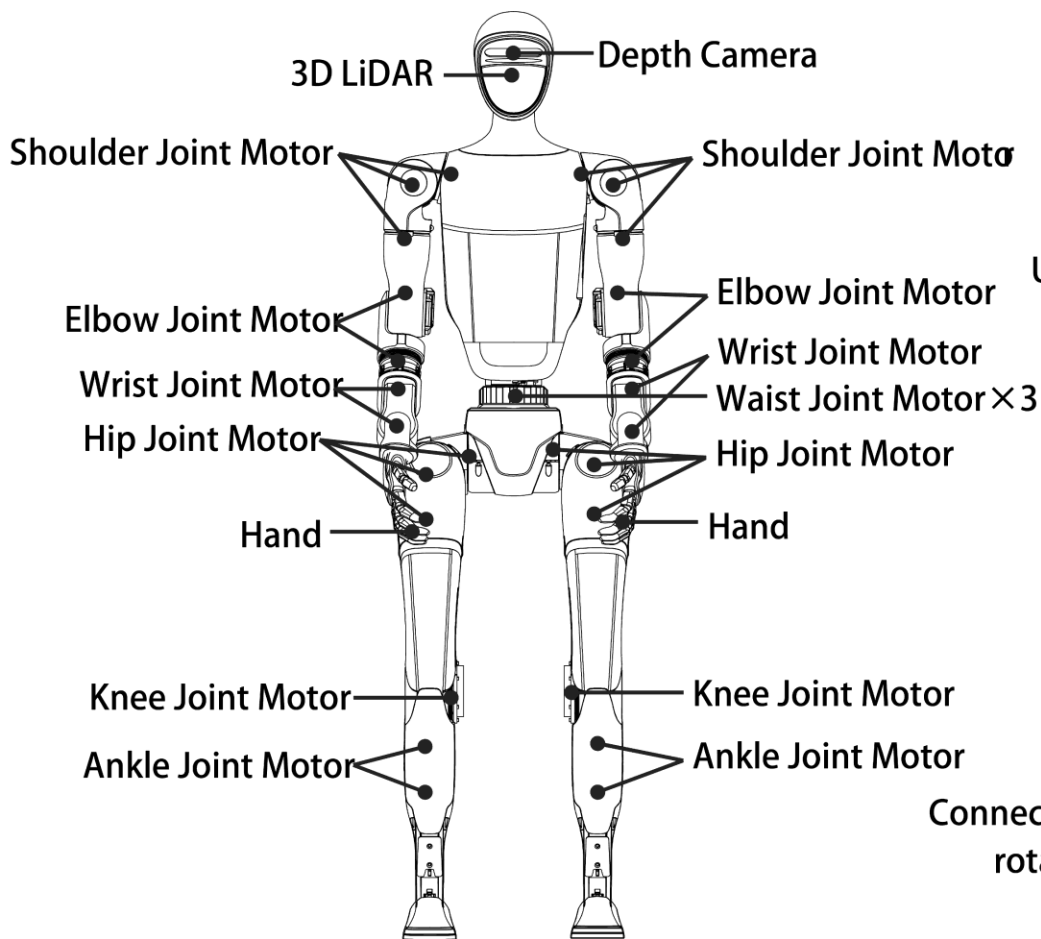
www.agentspace.org/kv



Unitree G1



- Developed by Unitree
- 7 + 7 DoF per each arm+hand
- AX-12W smart servos with encoder
- tactile sensors in the hand
- no neck
- Intel RealSense depth camera
- LiDAR
- speaker
- 4-microphone array



On board computer: Jetson Orin



- 2.2 GHz
- 32 GB VRAM
(memory shared by CPU and GPU)
- LAN, Wifi



Accumulator

- Robot is only running from the battery
- Battery indicates its capacity by number of green LEDs (4 .. Full, 1 .. empty)
- Pay attention to exchanging of the battery, mainly when the robot is not hanging

How to start

- Let the robot to hang from its crane, but slightly stand on ground
- Power up the robot: short and long push
- Power up the remote control: short and long push
- zero torque mode → L2+B → dump mode
- dump mode → L2+arrowup → ready mode
- ready mode → R2+A → walk run mode

Remote Controller

- Control the robot via Bluetooth



How to control

low API	high API
Unitree SDK	
DDS	
ROS	
Motors & Sensors	

Data Distribution Service (DDS)

```
import time
from unitree_sdk2py.core.channel import ChannelPublisher, ChannelFactoryInitialize
from user_data import *
```

```
ChannelFactoryInitialize()
```

```
# Create a publisher to publish
# the data defined in UserData class
pub = ChannelPublisher("topic", UserData)
pub.Init()
```

```
for i in range(30):
    # Create a Userdata message
    msg = UserData(" ", 0)
    msg.string_data = "Hello world"
    msg.float_data = time.time()

    # Publish message
    if pub.Write(msg, 0.5):
        print("Publish success. msg:", msg)
    else:
        print("Waitting for subscriber.")

    time.sleep(1)
```

```
pub.Close()
```

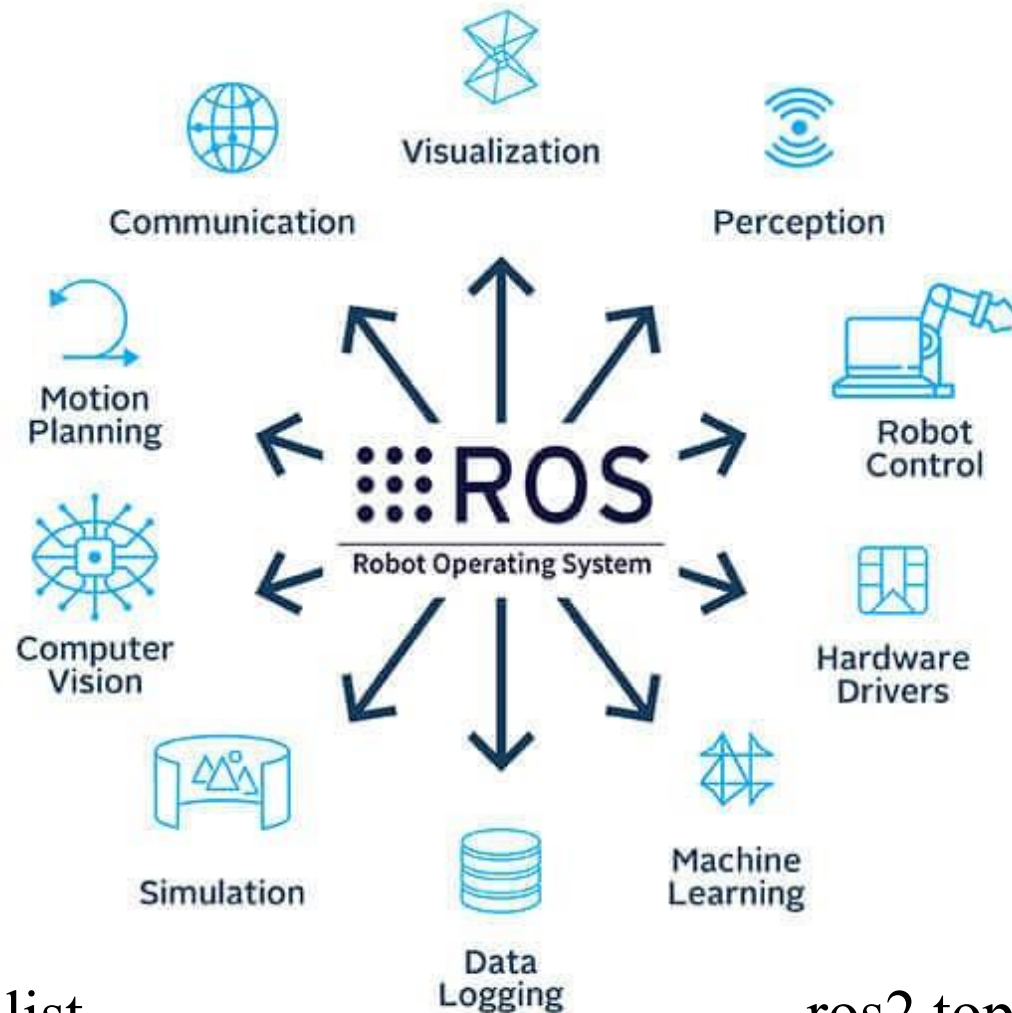
```
ChannelFactoryInitialize()
```

```
# Create a subscriber to subscribe
# the data defined in UserData class
sub = ChannelSubscriber("topic", UserData)
sub.Init()
```

```
while True:
    msg = sub.Read()
    if msg is not None:
        print("Subscribe success. msg:", msg)
    else:
        print("No data subscribed.")
        break
```

```
sub.Close()
```

Robot Operating System (ROS)



`ros2 topic list`

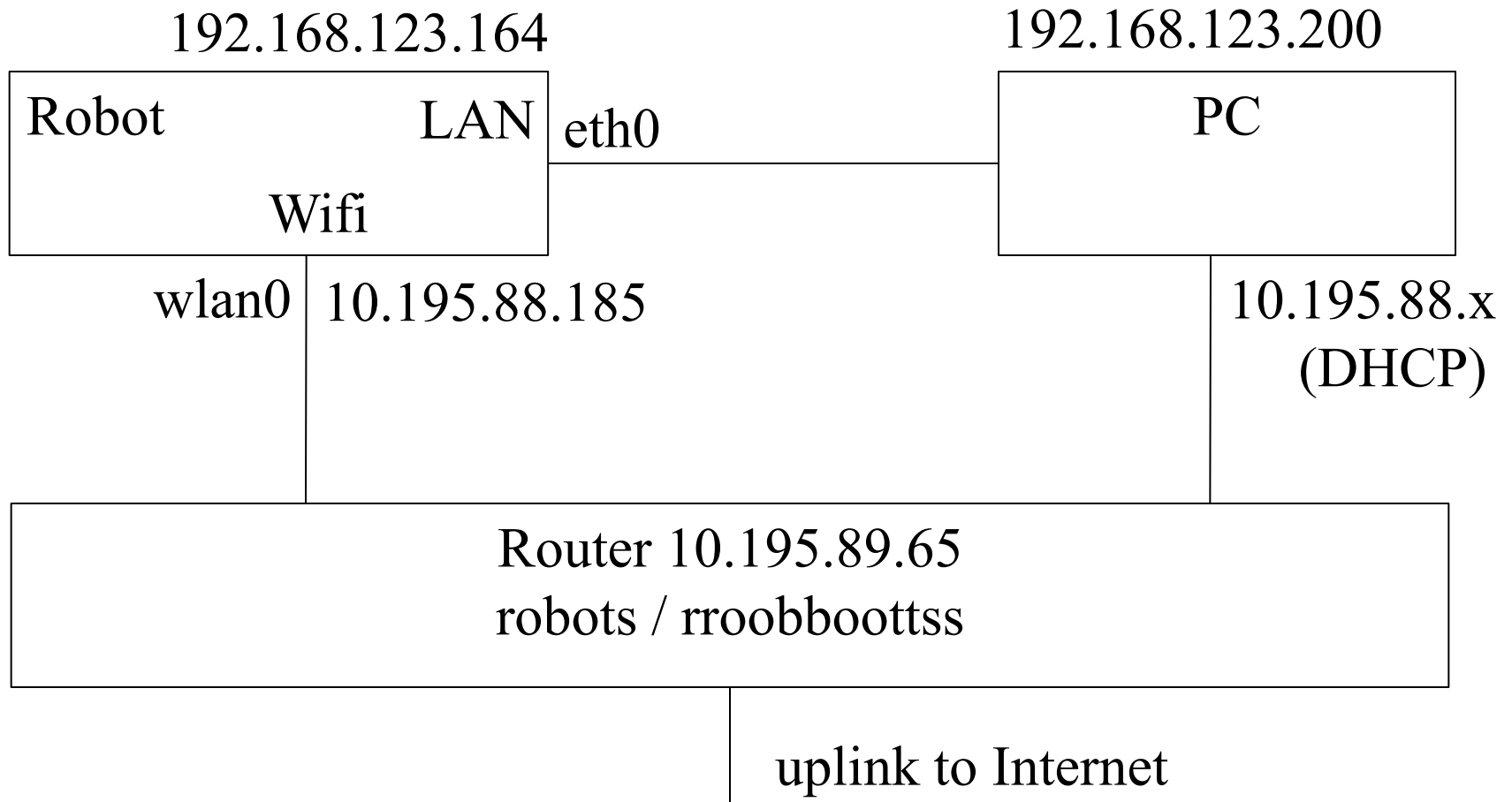
`ros2 topic echo <topic>`

Docs & Examples

- `git clone https://github.com/unitreerobotics/unitree_sdk2_python.git`
`git clone https://github.com/unitreerobotics/dfx_inspire_service.git`
`git clone https://github.com/unitreerobotics/unitree_sdk2.git`
- `unitree_sdk2_python\example\`

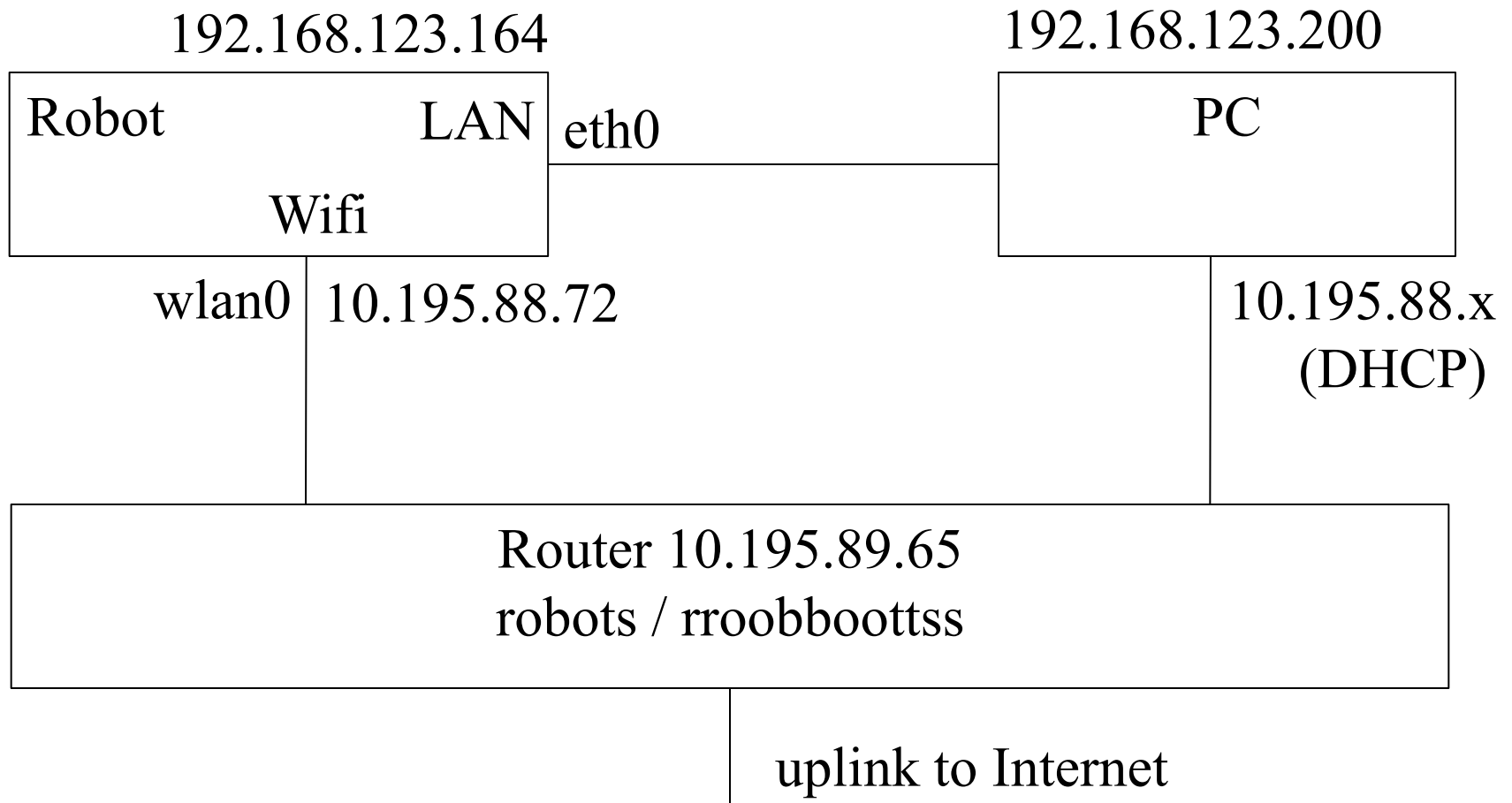
API docs: https://support.unitree.com/home/en/G1_developer

Network



(The IP address of the robot is static, so it is not visible in the DHCP clients on the router)

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Wifi

- by default, it is disabled
- First, connect via cable
- when it is enabled, use **sudo nmtui** for configuration

- use the command to start:

```
sudo nmcli dev wifi connect <SSID> password prenadnica
```

- our robot automatically connects to **robots**

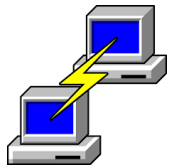
Remote access

ssh unitree@192.168.123.164

password: <ask teacher>

ros:foxy(1) noetic(2) ?

1 .. means ROS2, 2 means ROS1



putty ... remote access (shell)

File transfer

```
scp unitree@192.168.123.164:x/y .
```

```
scp y unitree@192.168.123.164:x/
```



WinSCP ... file transfer

no GUI, no VNC

- The robot is not running any GUI
- It is not possible to use VNC
- Problems:
 - seeing image from camera
 - comfortable configuration

Python

- Use always `python3`

How to walk: LocoClient

```
from unitree_sdk2py.core.channel import ChannelFactoryInitialize
from unitree_sdk2py.g1.loco.g1_loco_client import LocoClient
```

```
ChannelFactoryInitialize(0, 'eth0')
```

```
sport_client = LocoClient()
sport_client.SetTimeout(10.0)
sport_client.Init()
```

```
sport_client.Move(0.3, 0, 0) # move forward
time.sleep(1)
```

```
sport_client.Move(0, 0.3, 0) # move to a side
time.sleep(1)
```

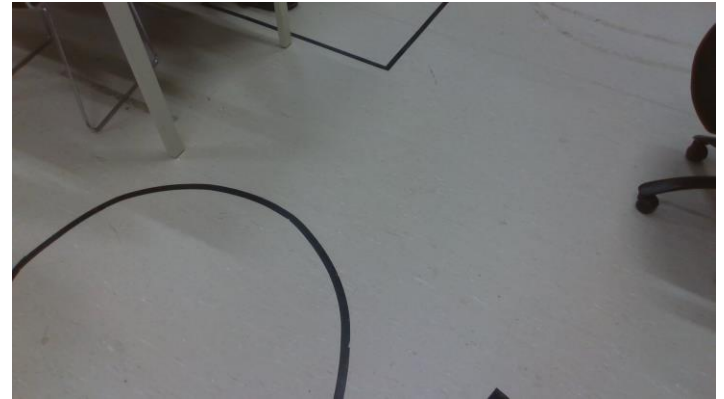
```
sport_client.Move(0, 0, 0.3) # rotate
time.sleep(1)
```

How to read images from the camera

```
from unitree_sdk2py.core.channel import ChannelFactoryInitialize
from unitree_sdk2py.go2.video.video_client import VideoClient
```

```
ChannelFactoryInitialize(0, 'eth0')
```

```
client = VideoClient()
client.SetTimeout(3.0)
client.Init()
```



```
errcode, jpegdata = client.GetImageSample()
if errcode == 0:
    import cv2
    import numpy as np
    jpegdataarray = np.array(jpegdata, np.uint8)
    data = np.frombuffer(jpegdataarray, np.uint8)
    img = cv2.imdecode(data, cv2.IMREAD_COLOR)
    cv2.imwrite('img.png', img)
```

Speech Synthesis

```
import time
from unitree_sdk2py.core.channel import ChannelFactoryInitialize
from unitree_sdk2py.g1.audio.g1_audio_client import AudioClient

ChannelFactoryInitialize(0, 'eth0')

audio_client = AudioClient()
audio_client.SetTimeout(10.0)
audio_client.Init()
audio_client.SetVolume(100)

audio_client.TtsMaker("Hallo",1) # 1 means English
time.sleep(1)
audio_client.LedControl(255,0,0)
time.sleep(1)
audio_client.LedControl(0,255,0)
time.sleep(1)
audio_client.LedControl(0,0,255)
```

non-blocking

Further tasks

- Speaker, speech synthesis
- Microphone, speech recognition
- LIDAR, obstacle detection
- Running AI models
(easy only via OpenCV)