# 護理機器人

🤖 **Medicare Robot**

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# Outline

# 1.0 Motivation and Objective

**■ Motivation:**

在COVID-19的疫情肆虐下，護理師...

1. 作業壓力增加

2. 接觸感染風險增加

**■ Objective:**

打造一台防疫機器人，能夠...

1. 輔助照顧病人

2. 減少非必要接觸

3. 勝任日常工作

4. 警急情況提供協助

# 1.0 Scenario

1. 根據醫療人員指示拿取相對應的藥物

2. 跟著醫療人員或導航移動至病床

3. 確認病人身分

4. 聽從醫療人員指示給予藥物

5. 自行走回藥庫待命

# 護理機器人
# 1.0 Scenario

1. 根據醫療人員指令拿取相對應物品放到平台

在護理站

拿消毒水 → EiH Cam (Eye in Hand) → 偵測酒精噴灑器、藥盒位置 ArUco → 把物體從桌面放入平台
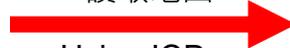
2. 跟著醫療人員或自行導航移動至病床

日常巡航 → Lidar Velodyne → 讀取地圖 Using ICP Point Cloud Matching → 導航移動、避障
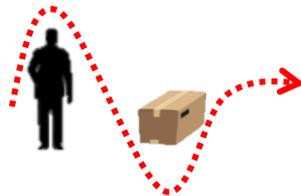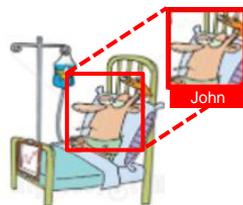
緊急情況 → RGB-D Cam → 偵測人的位置 Using yolov2 → 跟著人移動
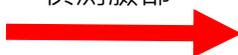
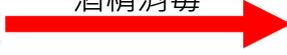# 護理機器人
# 1.0 Scenario



3. 尋找病患

確認病患資訊 → 偵測臉部 → John → 取得病患資訊
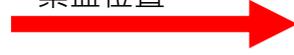
4. 聽從醫療人員指示給予藥物

給他退燒藥 酒精消毒 → 偵測酒精噴灑器、藥盒位置 ArUco → 夾取並把物體放在病床

5. 自行走回倉庫

回去待命 → 讀取地圖 → 導航移動、避障

**護理機器人**
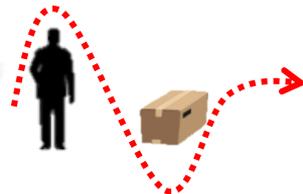
# 1.0 Contribution

- 林晉暘
  1) Navigation with 3D Lidar
  2) Learning-Base Face Recognition
  3) Robot Arm Integration
- 張少鈞
  1) GUI
  2) System Integration
  3) Aruco
- 黃郁翔、黃堯
  1) Human Following by Yolo v2
  2) Gripper Control
  3) Arm Control

# 2.0 System Setup
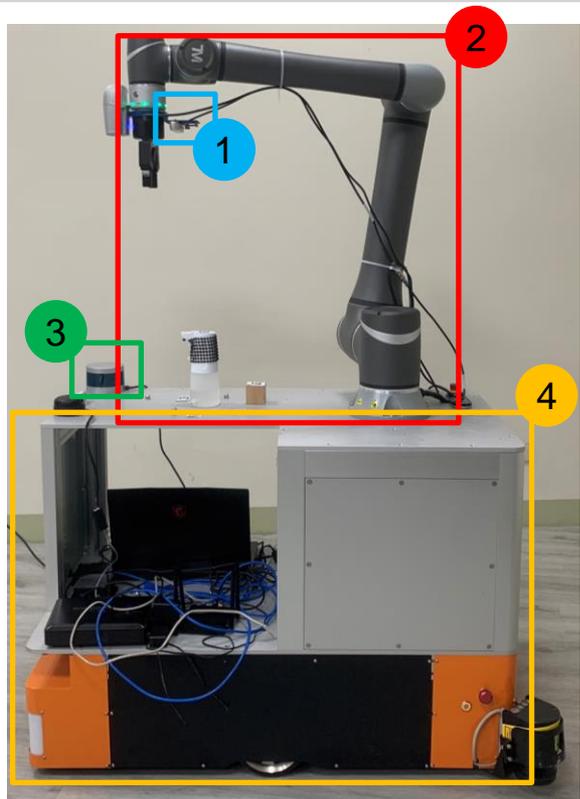


**1. EiH RGB-D 深度相機**
Realsense D415
辨識物品

**2. 機械手臂、夾爪**
抓取、給予物品以及
移動相機

**ROS**
Ubuntu 20.04
Wi-Fi

**3. 3D Lidar**
VLP-16
建置三維點雲地圖
進行定位導航

**4. 自走車**
移動至目標地點

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# 2.0 System Functions
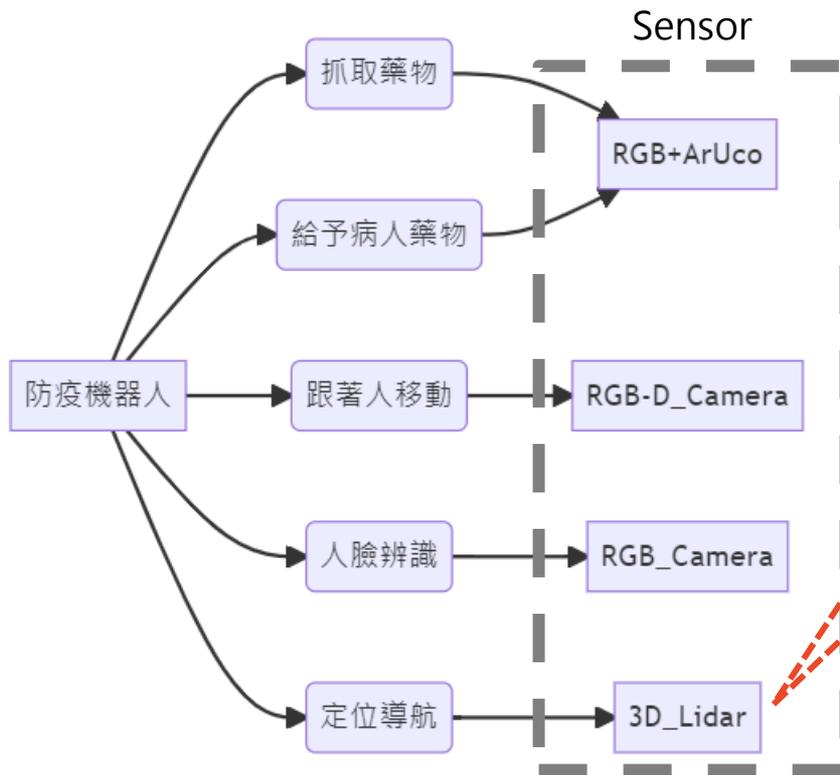
Sensor



| Sensor | 攝影機 | 3D Lidar 光達 |
|---|---|---|
| 探測角度 | 30。 | 360。 |
| 測距精度 | 低 | 高 |
| 頻率 | 低 | 高 |
| 成本 | 適中(6000元) | 高(90000元) |
| 環境限制 | 影像模糊與光度影響 | 大雨或透明玻璃 |

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# 2.0 System Flowchart

**Graphical User Interface**

**Robot**

**MASTER**

| 3D LiDAR | → Point Cloud → | RTAB-Map Fusion SLAM |
|---|---|---|

3D Map Pose

Mobile Manipulator ← velocity commands ← Navigation — Obstacle Avoidance

Goal

Yolo v2 — Human Tracking

Real Sense Camera → RGB-D → Face Recognition — Learning-Based

Detection Image

Robot Arm ← Arm Control ← ArUco — Pose Estimation

Object

# 3.1 Two-Stage Navigation



SLAM

Odometry

Mapping and Optimization

Mapping

Front End

wheels encoders

Back End

Lidar

RTAB-Map

offline

online

**Fixed** Map with Grid and Point Cloud

Input：
Map, Odom, Scan, Goal
**Output**：Trajectory

Localization

RTAB-Map

Loop Closure With "ICP"

Move Base

Coordinate

wall

L$_a$

3D LiDAR

T$_{La}$

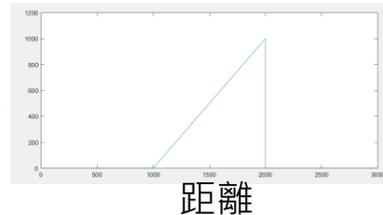(pos_x, pos_y, pos_z)

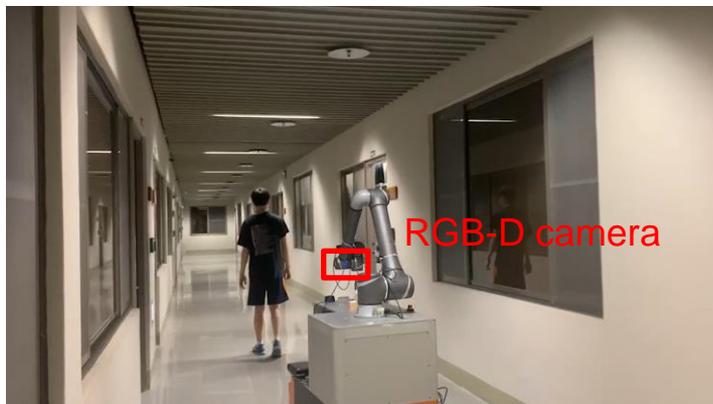Encoder + Lidar

Obstacle Avoidance

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# 3.2 Human Following Using Yolo v2

速度

距離



Extract Depth of Box Center

RGB-D camera

Human Following

1. **Video Stream**: Subscribe to realsense RGB and Depth image, run yolov2 in darknet and ROS environment.
2. **Detect Human**: Draw bounding box only when human is detected and extract box center.
3. **Distance estimation**: extract the depth data by bounding box and RGB-D camera.
4. **Output velocity command**: Move faster if distance is far, slower if close.
5. **Handle exception**: Stop immediately if no person is detected or the person is to far away.

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# 3.3 Visual-Guided Robot Arm Control
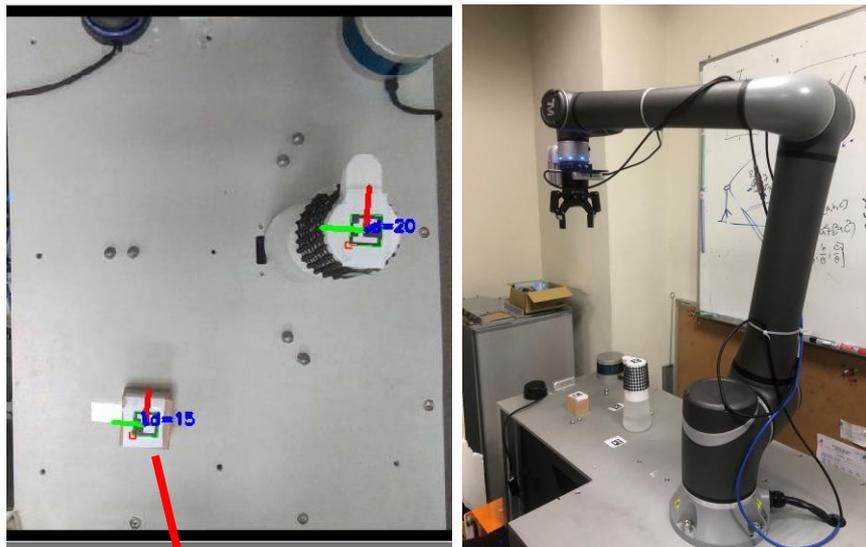


1. Identify all objects with ArUco
2. Get ArUco id to find the target object
3. Calculate the translation and then pick up the object

ArUco

1) **Video Stream:** Subscribe realsense RGB image msgs.
2) **Pose Estimation:** Get AruCo object to camera transform.
3) **Coordinate transform:** camera frame to gripper frame.
4) **Robot Arm Control:** Grab/Put the object to target place.



藥盒

酒精
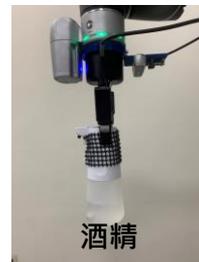
# 3.4 Learning-Based Face Recognition

Database Image



Real-time image



John      Sam      Yao Hwang      Unknown

Face Recognition (D-lib)

1. Create database: save the image and save face encoding of each person to the folder.
2. Video Stream: Subscribe realsense RGB image msgs.
3. Recognize: Using real sense camera and start recognizing.
4. Comparison: Compare the image display on real-sense with the image in database.
5. Result: Draw the box and print out the persons name, or "Unknown".

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# 3.5 Graphical User Interface (GUI)



Show
Point Cloud

RealSense
image

Interrupt

Yolo V2
control

Navigate to (0,0)
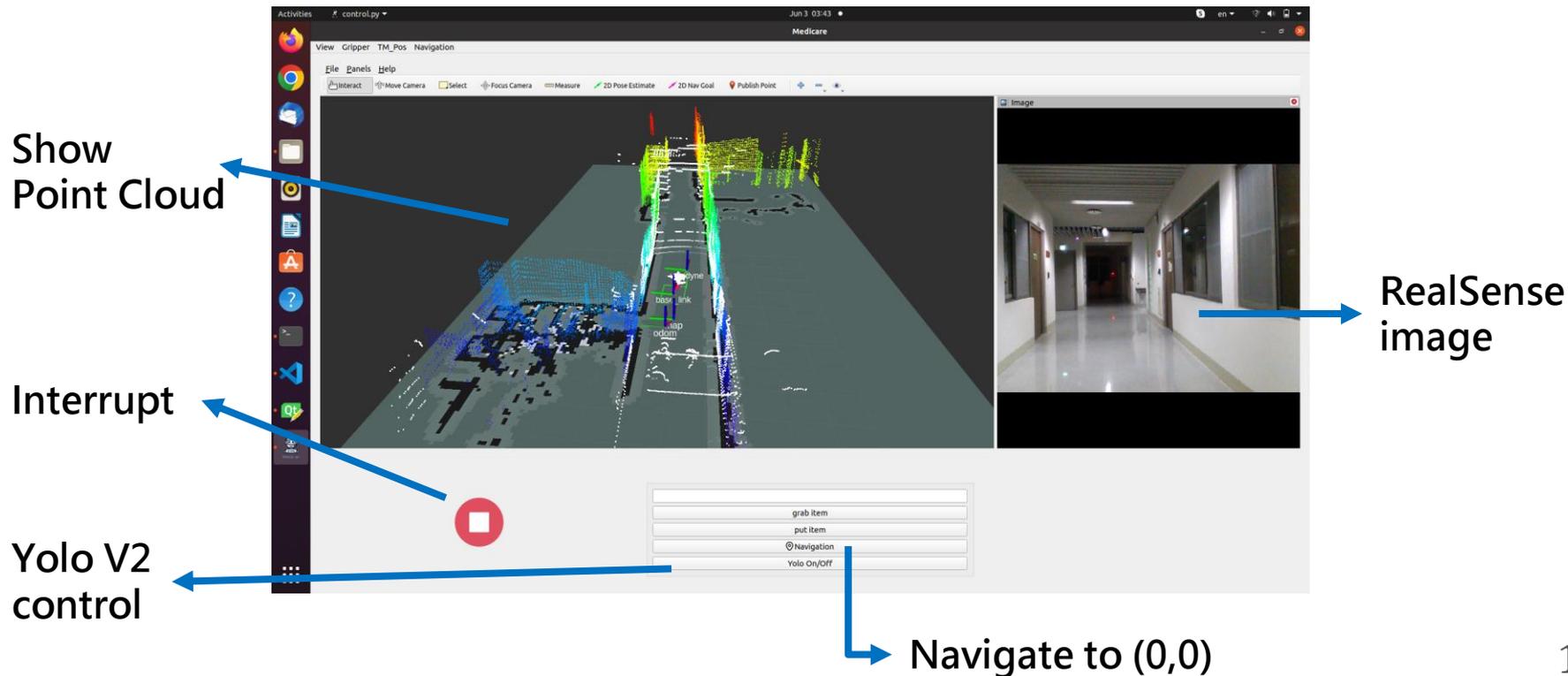
# 3.5 Graphical User Interface (GUI)

1.1) Node Checker
  ➤ Check ROS node is available or not
1.2) Amm Control
  ➤ Control AMM by clicking the button
  ➤ Set speed
1.3) Arm Control
  ➤ Monitor Robot Arm position
  ➤ Set increment
  ➤ Interrupt Robot Arm
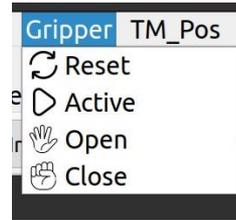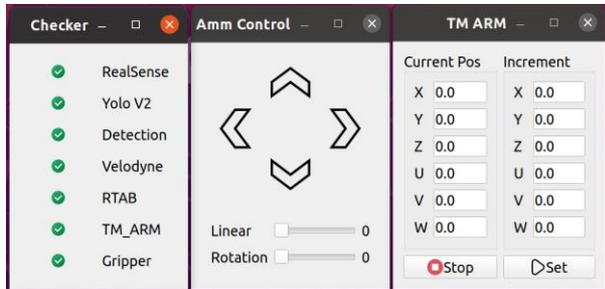
2) Gripper control
  ➤ Active
  ➤ Reset
  ➤ Open
  ➤ Close
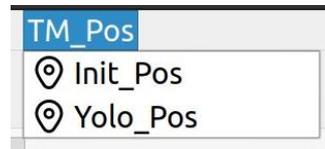
3) Set TM to pre-defined position
  ➤ Init_Pos
    - Grab item
  ➤ Yolo_Pos
    - Follow human

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# 4.0 Experimental Results