

Towards Practical Deployment of RMF on Panasonic HOSPI Robot

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10th November 2022

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Panasonic

Panasonic Asia Pacific Co. Ltd



Panasonic Group

Headquarter : Osaka, Japan

Foundation : 1918

No. of Employees* : 240,198

Sales (FY22) : 7,389 bil JPY (82.2 bil SGD)

*as of 31st Mar.2022



Group CEO : Yuki Kusumi

Panasonic Group Business



Lifestyle

- Refrigerators
- Air purifiers
- Air-conditioners
- Showcases
- Lighting
- Wiring devices

Automotive

- Cockpit systems
- Vehicle camera modules
- Head-up displays (HUD)

Connect

- Supply chain management software / solutions
- In-flight entertainment systems
- Electronic component mounting-related systems
- PCs / Projectors

Industry

- Motors for industrial application
- Multi-layer Circuit Board Materials
- Capacitors

Energy

- Cylindrical lithium-ion batteries for in-vehicle use
- Battery modules for power storage
- Dry batteries

Entertainment & Communication

- TV
- Digital Camera
- True Wireless Earbuds

Housing

- Kitchen Furniture, Bathroom & Sanitary Fittings products
- Interior products

Our New Brand Slogan

Live Your Best

In an ever-changing world, we continue our efforts to make life simpler, safer, healthier, more enjoyable, and more sustainable.
Efforts to help our customers live their best.



We will support the environment and well-being of lifestyle & workstyle

Robotics Ecosystem in Singapore



The National Robotics Programme (NRP) is a multi-agency national programme that looks at the end-to-end development of differentiating robotics enablers and solutions in Singapore, from funding R&D to facilitating partnerships for translation and adoption to maximise socio-economic impact.

Partners

Public Agencies & Offices



Institutes of Higher Learning (IHLs) & Research Institutes (RIs)

Robotics Ecosystem in Singapore – Industry



Panasonic's AMR (Autonomous Mobile Robot)

Indoor delivery AMR

HOSPI



Robotic mobility

PiMo

Wireless following

Auto pilot **Under Development**



Semi autonomous

Full autonomous

Autonomous delivery robot "HOSPI"

This is our autonomous delivery robot, HOSPI. Example use cases include transporting drugs, specimens, materials, etc., at hospitals.



HOSPI(Normal type)

<Specification>

Size : W630mm×D705mm×H1,390mm
Weight : About 170kg
PayloadSize : W327mm×D446mm×H390mm
Capacity : About 20kg
MaxSpeed : 1.0m/sec
RunningTime : 7 hours / 2.5 hours for charging
(Subject to change according to operation environment)

Security



Authentication with an ID card is required for operation

Storage

By default, 3 trays can be stored



Standard tray

<Specification>

Payload Size : W548mm×D348mm×H197mm
Material : ABS

Storage can be customized freely

drugs



Standard tray



Customizable

specimens



Test tube



Urine examination

Strengths of Our Technology

Unique Value Propositions & Competitive Advantages

High safety technology

- ISO 13482* compliant robot 1st in the world
(*Safety requirements for personal care robots)
- HOSPI can safely operate in public areas with close human-robot interaction

Obtained the world's first ISO 13482 JIS standard certification for autonomous mobile robots



Reliable track record

- 9+ years of experience in providing robot solutions in Singapore
- Delivered 27 robots in 11 hospitals worldwide
- Earned the trust of customers by providing unfaltering robotic solution



Adapted RMF

- Panasonic is **Empowered System Integrator (SI) of RMF**
- Lift & door integration
- Fleet management system

Integration with Auto door and lift



High Safety

HOSPI has never had an accident in 9 years since it started operation.
HOSPI will inform surrounding people by voice while moving.

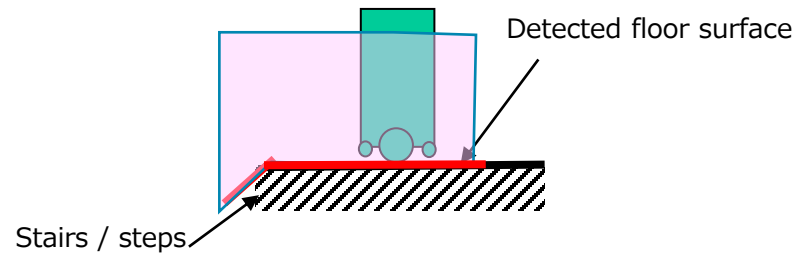
Ledge-drop prevention

Dual preventive measures will be taken in places where there is a risk of falling from escalators, stairs, etc.



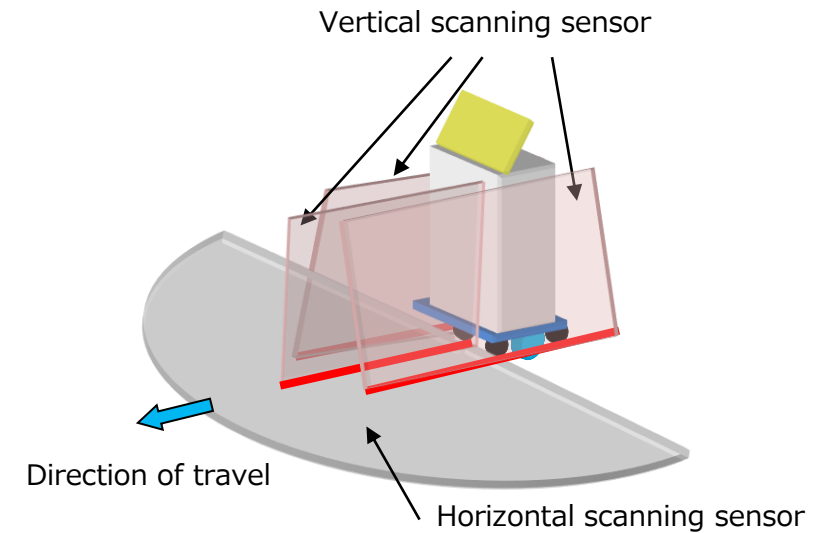
1 Register virtual wall in map
(Recognize dangerous places)

2 Sensors detect stairs and escalators
(Stop at a dangerous places)

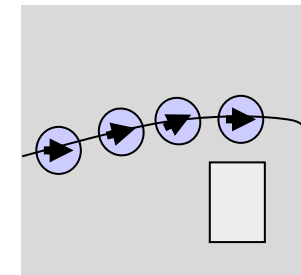


Obstacle avoidance

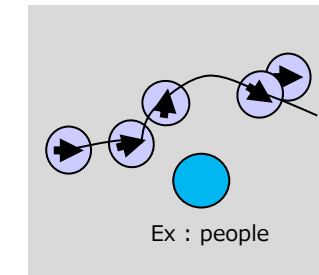
• sensor structure



• avoidance behavior



In case of static obstacle



In case of dynamic obstacle

Panasonic's Capability & Contribution to Singapore

Panasonic will contribute to the deployment of **RMF** to society through our robot business.

Panasonic's RMF capabilities

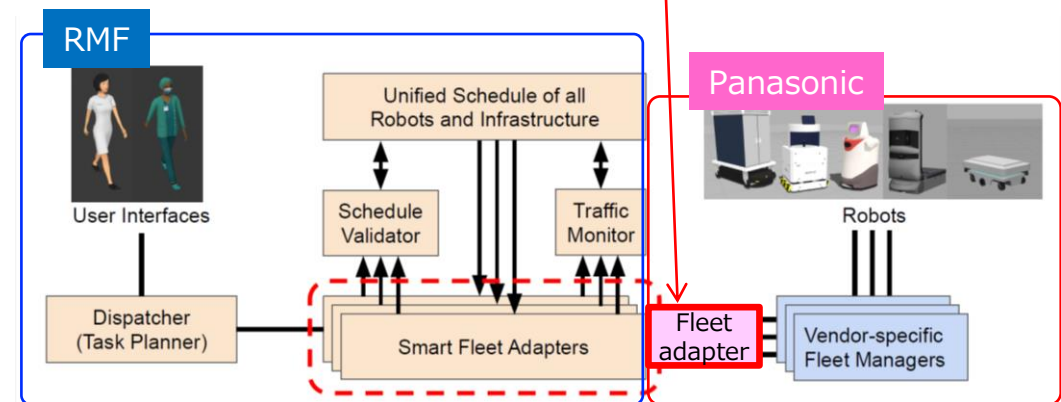
- 1: We have adapted RMF to **commercialized AMR** (adapted level : Middle) ※Robot system using Windows
We also adapted RMF to **prototype AMR** (adapted level : High) ※Robot system using ROS2
- 2: We can integrate many kinds of **devices** for RMF
- 3: We have capability of integrating **robot system** using RMF. We are one of the RMF empaneled SI vendor.
- 4: We have some experience integrating AMR to Xnergy(Singapore startup) **contactless charger**.

1: Commercialized AMR adapted to RMF

We have commercialized AMR



We are developing our own RMF-compatible fleet adapter



Using ROS2 system, we can adapt to Full Control level

Ad hoc delivery operation in Hospital

- Regarding Ad hoc delivery, AMR delivery each items to a specific destination from ward, after receive delivery request from each Wards
- The destination is selected by the staff for each item when the robot is at the loading point

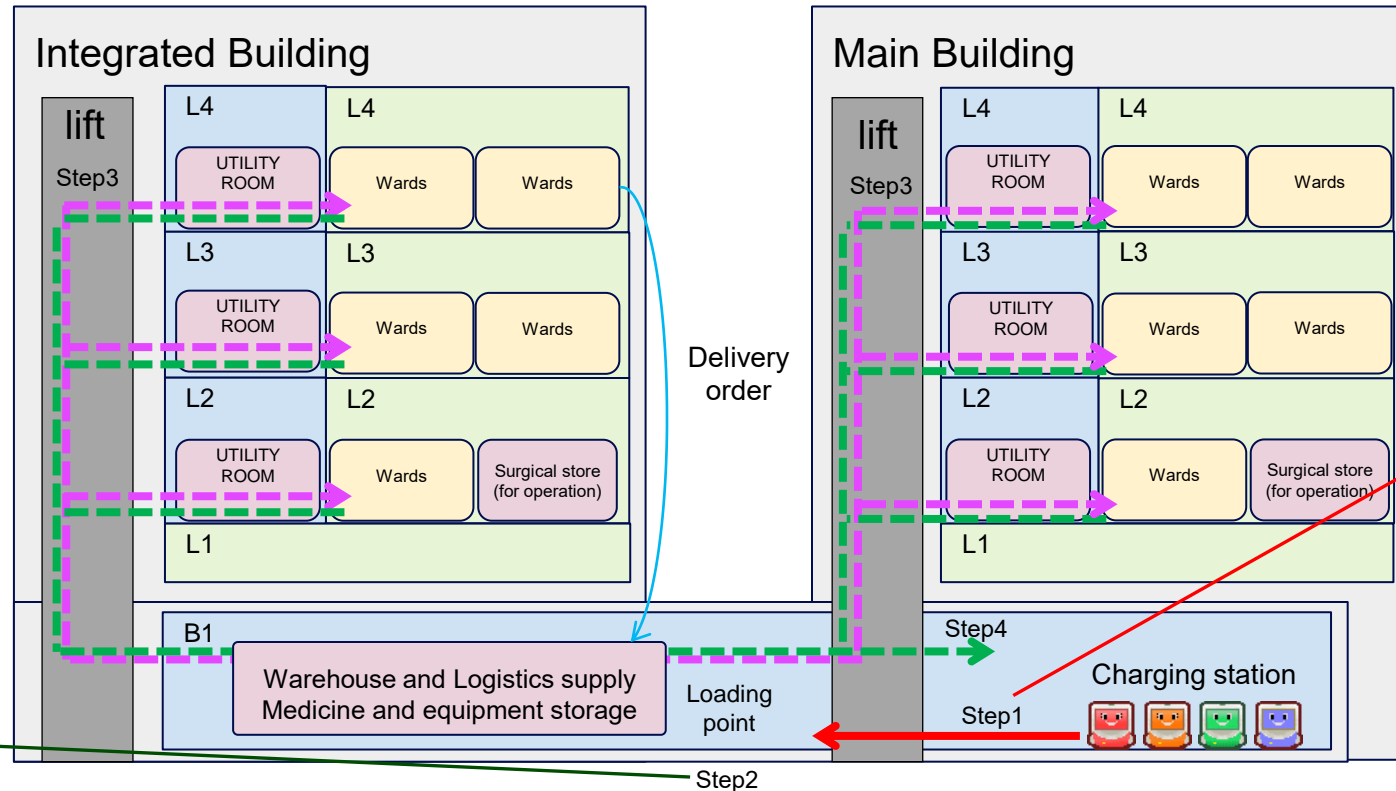
Step1: Call the robot from the charging station or the nearest position to the loading point (Any robot will do)

Step2: Staff load the items to robot at Loading point and select a destination (The task done by the AMR which staff operated)

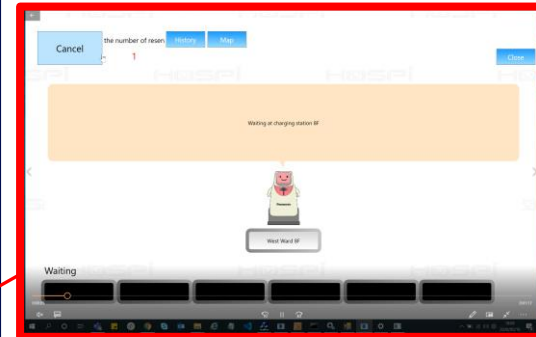
Step3: Deliver the items to destination

Step4: After delivery, when the staff presses the return button, AMR moves to the charging station and charges

Staff select a destination after load items



Staff call the nearest robot



Required specification for RMF

Due to the AMR operation in hospital, the RMF should have the following function

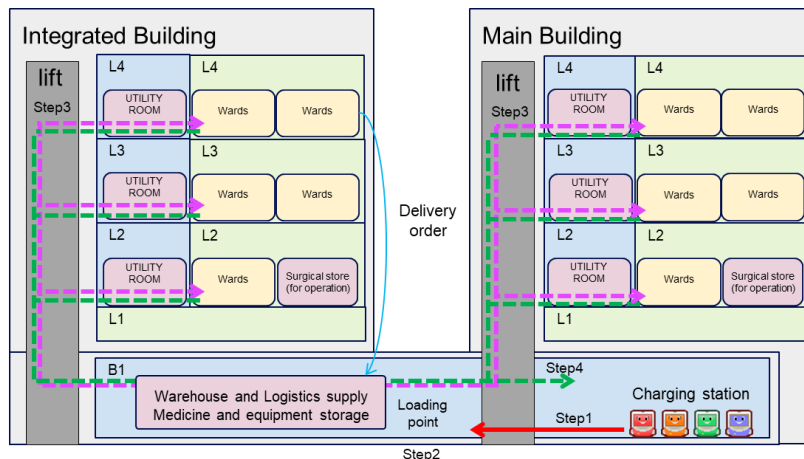
1: Setting the direction facing at the destination

2: Speed setting for each lane (speed adjustment)

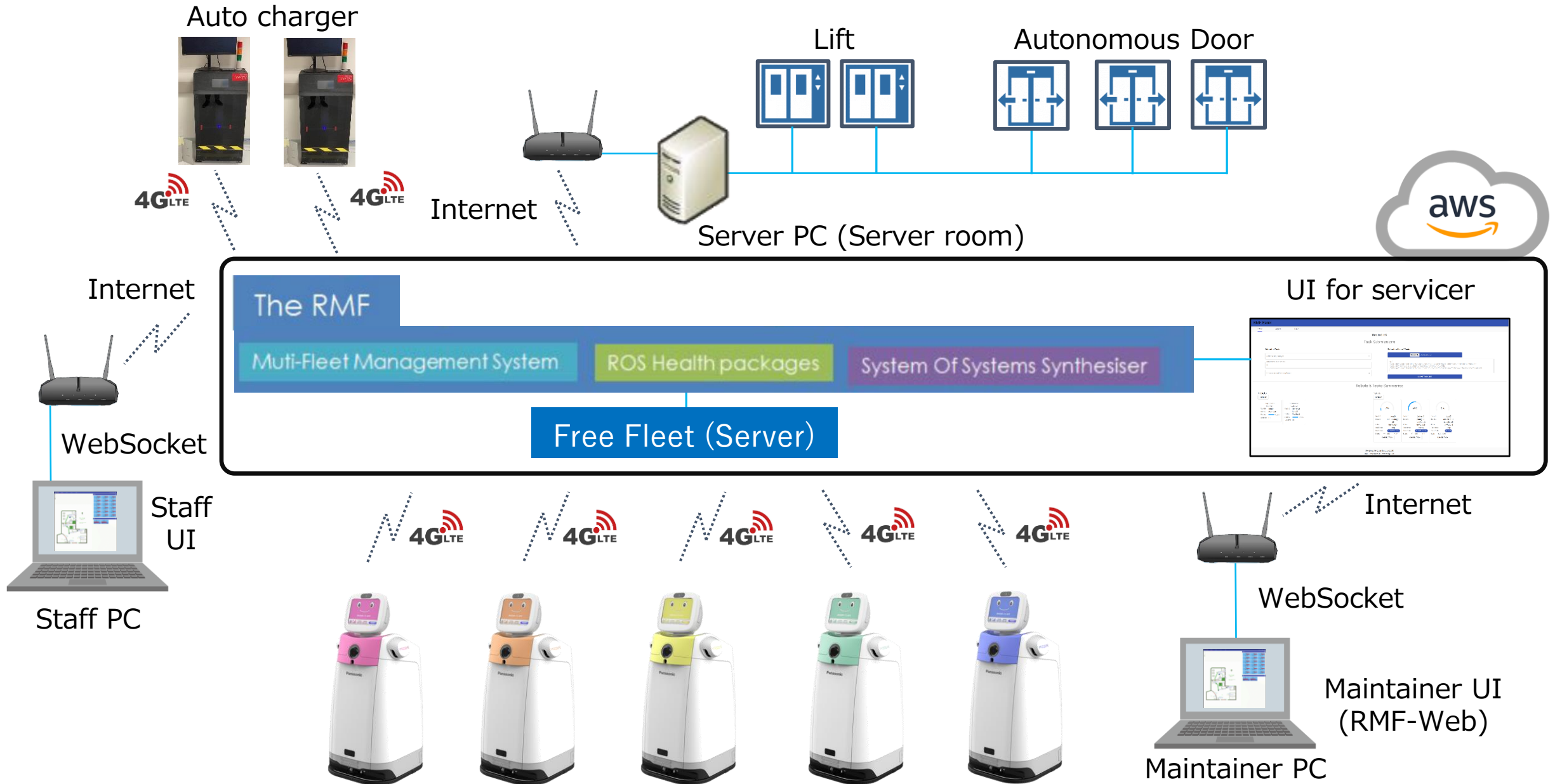


3: Allocating tasks to specific robots

4: Conduct Charging mode at Charger Locations



AMR System configuration diagram with RMF

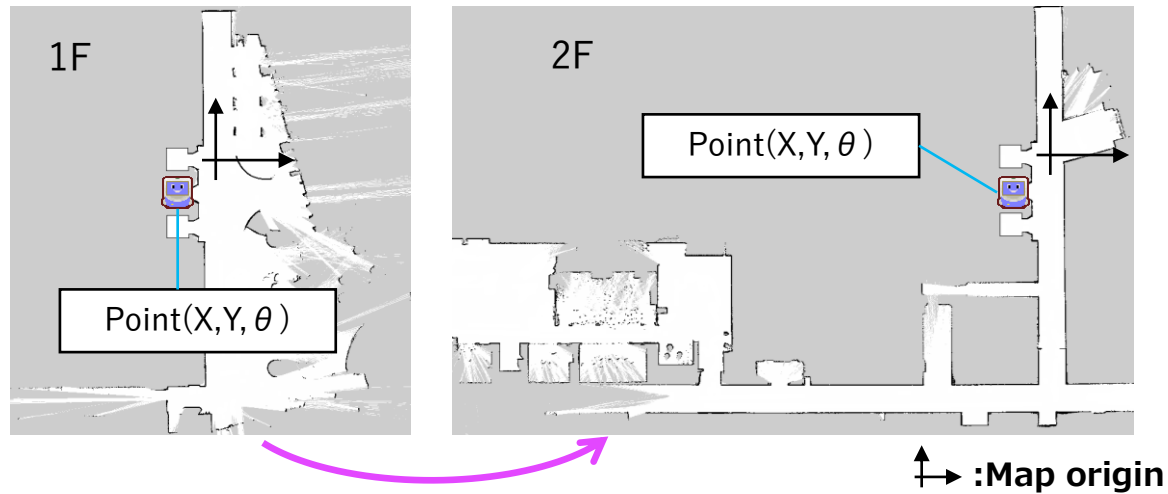


Preparation of AMR before using RMF

RMF maps are unified into one map for multiple Floors, but AMR only using 1 Navigation map
 Because of this, AMR side need to add Change Floor function in ROS Navigation

Two Ideas for AMR to Switch Maps

Switch Navigation map physically



Change Floor = Change map = Republish new map topic

Send coordinates to RMF

$(X, Y, \theta) \Rightarrow (X, Y, \theta)$ in 1F

$(X, Y, \theta) \Rightarrow (X, Y, \theta)$ in 2F

Advantages

Don't need map merging

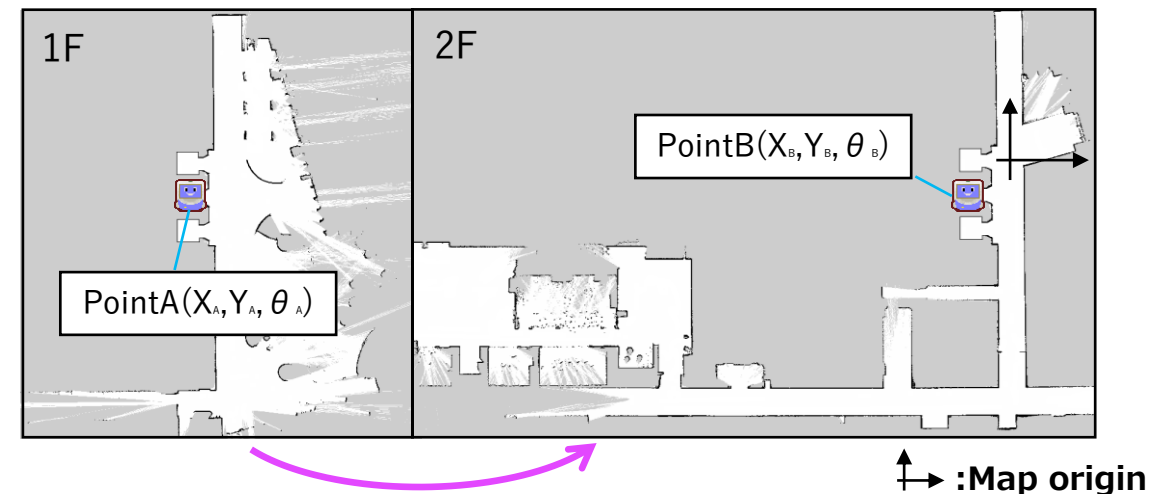
Don't need offset parameter

Disadvantages

Need to align map coordinates

Mapsever needs modification

Retatch the robot's position in Navigation map



Change Floor = Change position = Resend initial pose again

Send coordinates to RMF

$(X_A, Y_A, \theta_A) \Rightarrow (X, Y, \theta)$ in 1F

$(X_B, Y_B, \theta_B) \Rightarrow (X, Y, \theta)$ in 2F

Advantages

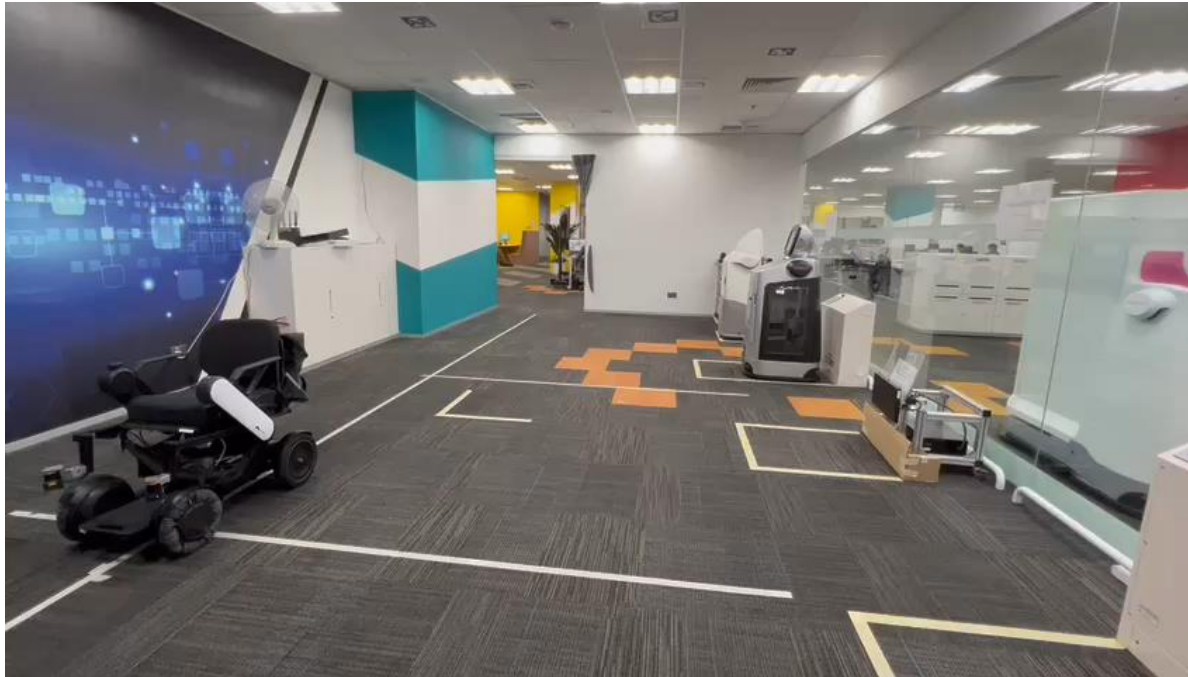
No need to align map coordinates

Mapsever don't needs modification

Disadvantages

Need offset parameter for each floor

Require map merging



Activities Firefox web browser Aug 24 10:11
RMF Panel - Mozilla Firefox
RMF Panel x Search | rmf_demo | rmf-cloud | rmf-cloud | rmf-cloud | WinCo... | list - Av... | Billing M... | docker ty... | How to g... | RMF Wel... | open-vm... | rmf-depl... | rmf-depl... | JustAct... | rmf-wel... | rmf-wel... | rmf-wel... | ROS Indu... | rmf/robo... | How to c... |
https://open-rmf.github.io/rmf-panel/

RMF Panel

RMF: Tell me what you want

Time is: 0:47:25

Task Submissions

Submit a Task

Select a request type
Loop

Set start time (mins from now)
0

Choose a priority (default: 0)
0

Schedule a Loop Request

Select start location
Pantry

Select end location
2F_lab

Number of Loops
1

SUBMIT REQUEST

Submit a List of Tasks

SELECT FILE

```
eg 1  
{  
  "task_type": "Loop", "start_time": 0, "priority": 0, "description": ["from_looper", "to", "finish_name", "source"],  
  "task_type": "Delivery", "start_time": 0, "priority": 0, "description": ["optimal", "task"],  
  "task_type": "Loop", "start_time": 0, "priority": 0, "description": ["from_looper", "start_name", "subtask_2", "finish_name", "supplier"]  
}
```

SUBMIT TASK LIST

Robots & Tasks Summaries

Robots

REFRESH

hospi_robot_1
Assigned Task
Status: Idle-0
Battery: 91%

Tasks

REFRESH

Pilot Trial at Galen, Smart Urban Co-Innovation Lab



2A: At Level 1 Lobby, HospiSignage offers concierge services to guests, indicates who and what are present



Demo of HOSPI and Lift Integration with RMF



Live Demo of HOSPI and Lift/Door Integration with RMF here at ARTC



Thank you for your attention!

**ROS-INDUSTRIAL ASIA PACIFIC
WORKSHOP**
9 - 10 NOVEMBER 2022

