ROS-Industrial Consortium Asia Pacific Updates

ROS Industrial America 2022 Annual Meeting

Darryl Lee
ROS-Industrial Asia Pacific Consortium Manager
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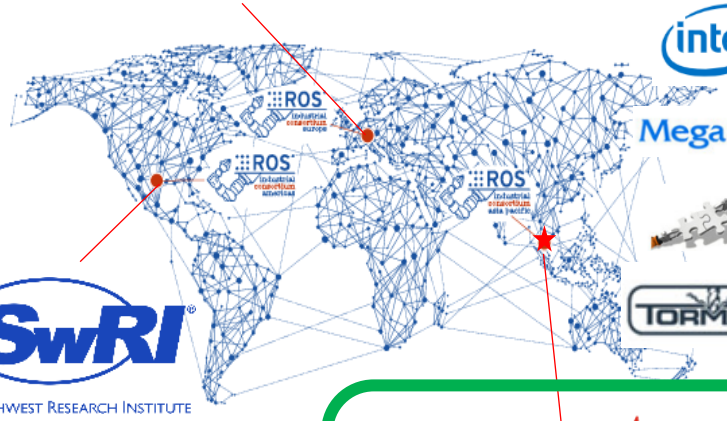
ROS Industrial Asia Pacific – Part of a Global Consortium

Fraunhofer IPA

ROS-Industrial Europe



SwRI Southwest Research Institute

ROS-Industrial Americas

ARTC

ROS-Industrial Asia-Pacific

3M, ABB Robotics, AFMan Tech United States Air Force, Alias Robotics Robot Cybersecurity, amazon, Amsted Rail, Bastian Solutions, Boeing, Bosch, BMW, CAT, FH Aachen University of Applied Sciences, FZI, Glidewell Laboratories, Hanwha Techwin, Harting, iav automotive engineering, INESCTEC, intel, Intelligrated, Joanneum Research, John Deere, KEBA Automation by innovation., Lely, Magna, MathWorks, MegaChips, Microsoft, NIST National Institute of Standards and Technology U.S. Department of Commerce, NOV, NRC CNRC, The University of Texas at Austin Nuclear Robotics Group, open robotics, Picknik, Pilz, Plus One Robotics, PPM, PushCorp, Inc., Rensselaer CATS, Saxion Hogeschool, SEC, Siemens, Spirit AeroSystems, synapticon, TARDEC, Tormach, traclabs, T-Systems Let's power higher performance, TU Delft, ubuntu Delivered by Canonical, Universal Robots, Wolf Robotics, Yaskawa

ADLINK Leading EDGE COMPUTING, Cognicept, Delta, Infineon, Johnson & Johnson, Kyocera, Nanyang Technological University Singapore, Omron, Panasonic, Pepperl+Fuchs, Republic Polytechnic, Schaeffler, SiAA, Singapore Polytechnic SP, Singapore University of Technology and Design SUTD, TDS, woodside, Yokogawa

Advanced Remanufacturing Technology Centre (ARTC)

Leading Public-Private Partnership Research Centre in SE Asia

Officially Opened on 28th January 2015

- **Mission – To Develop and Deploy Advanced Manufacturing Solutions and Upskill Workforce, to Drive Local Industry Competitiveness**
- **Bridging the gap between Research and Industry**
- **Co-Create and Value Capture with Industry through the Implementation of Solutions**

Attract and **Retain** more **MNCs** in Singapore

Steady and sustainable **increase in LLEs leveraging A*STAR tech** to boost competitive advantage

Steady and sustainable increase in **SMEs adopting baseline A*STAR technologies** to enhance productivity

Steady and sustainable increase in **SMEs tapping A*STAR** tech for **regional and international expansion**

Contribute **A*STAR tech to** address **Public Sector** needs

Invigorate the local **start-up** scene

EPD & EMD updates

Easy Perception Deployment (EPD)

A ROS 2 package that provides object vision capabilities that is easy to configure and deploy, with the support of state-of-the-art machine learning algorithms

EPD

- **Key Features**
  - Fast object detection, segmentation, localization, measurement and tracking
- **Recent Updates**
  - Dockerized of Exporter Environment for accelerated model training
  - Added toolset of bash scripts options for command line-users
  - Verified EPD to have good compatibility with Nvidia GPUs (RTX 5000, GTX 1060 and Quadro M1200)

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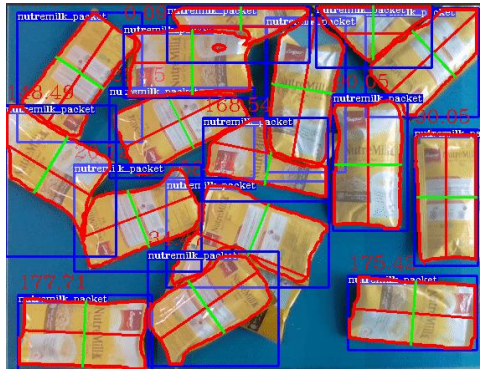
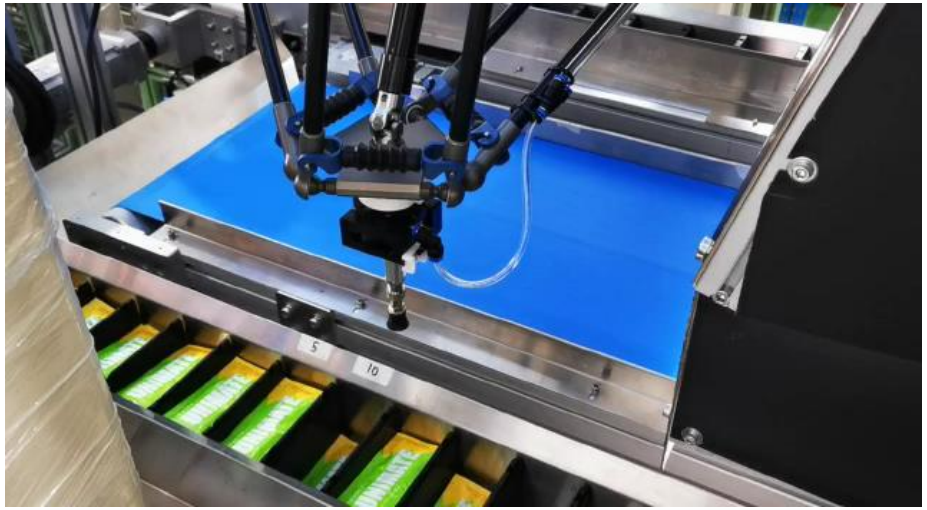
Industrial Use Case: Quick Sachet Picking





Problem Statement

The health supplement company has challenges on a manpower crunch and is keen to automate the sorting and packing of its powder sachets

The Solution

ROS-Industrial integrates EPD with commercially available industrial equipment (Camera/IPC/Delta Robot) to automate the sachet picking process

The Challenges

This is the first industry use case for EPD. Hence, efforts are required to resolve emergence bugs such as accurate detections, orientations, etc

Project Significance

- EPD utilises Open Standard ONNX AI, which removes overreliance on particular ML algorithms. Using ROS will allow the client to scale in future without lock-ins on the hardware
- Fully automate its tedious operations of sorting and packing sachets reducing the manpower needed from 16 to 2
- Target to achieve a Cycle time of 0.8 Sec pick per sachet

Easy Manipulation Deployment (EMD)

An easy-to-use ROS 2 manipulation package that provides a fast and flexible pipeline for pick and place tasks that can support a variety of grippers

- **Key Features**
  - Workcell Builder, Grasp Planner and Grasp Execution
- **Recent Updates**
  - Waypoint file loading
  - Converted the Dynamics Safety from Grasp Execution plugin to Controller plugin
  - Tested various collision elements with Dynamics Safety

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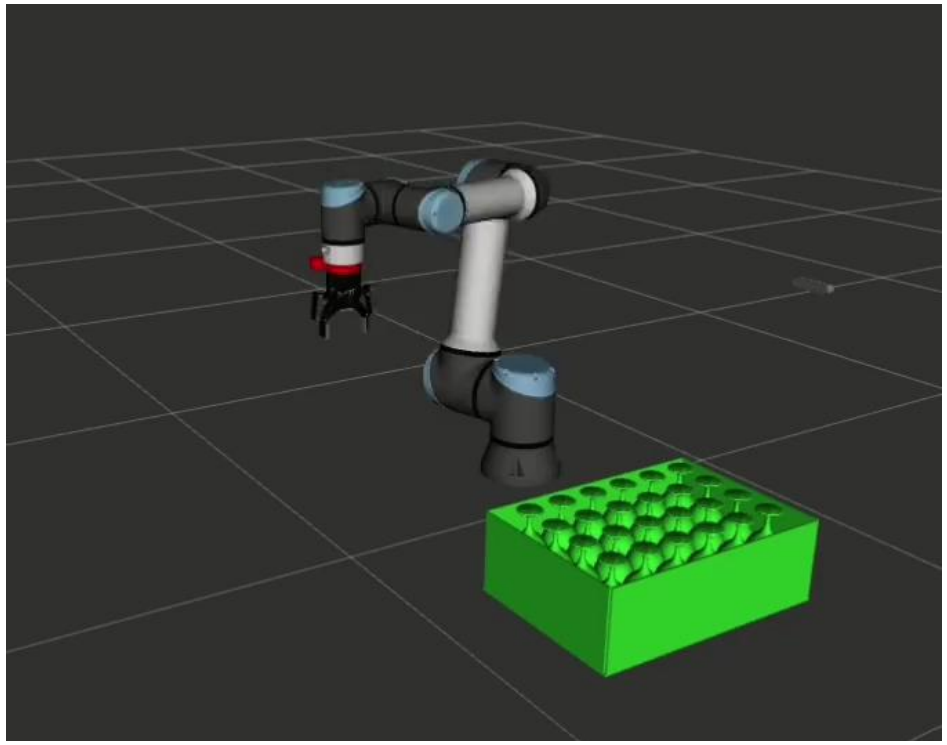
EMD Grasp Execution Improvements



- For high mix pick and place, there are situations requiring object-specific trajectories depending on the required place position
- Developed a **waypoint file loading** method for EMD grasp execution to easily configure and load trajectory specific tasks depending on the grasped object.
  - Useful in Workcell areas that require navigation in tight spaces
  - Helps to reduce undefined movement of manipulator during execution
- JSON format based configuration file provides easy to understand trajectory definition that can be configured and tweaked during hardware testing

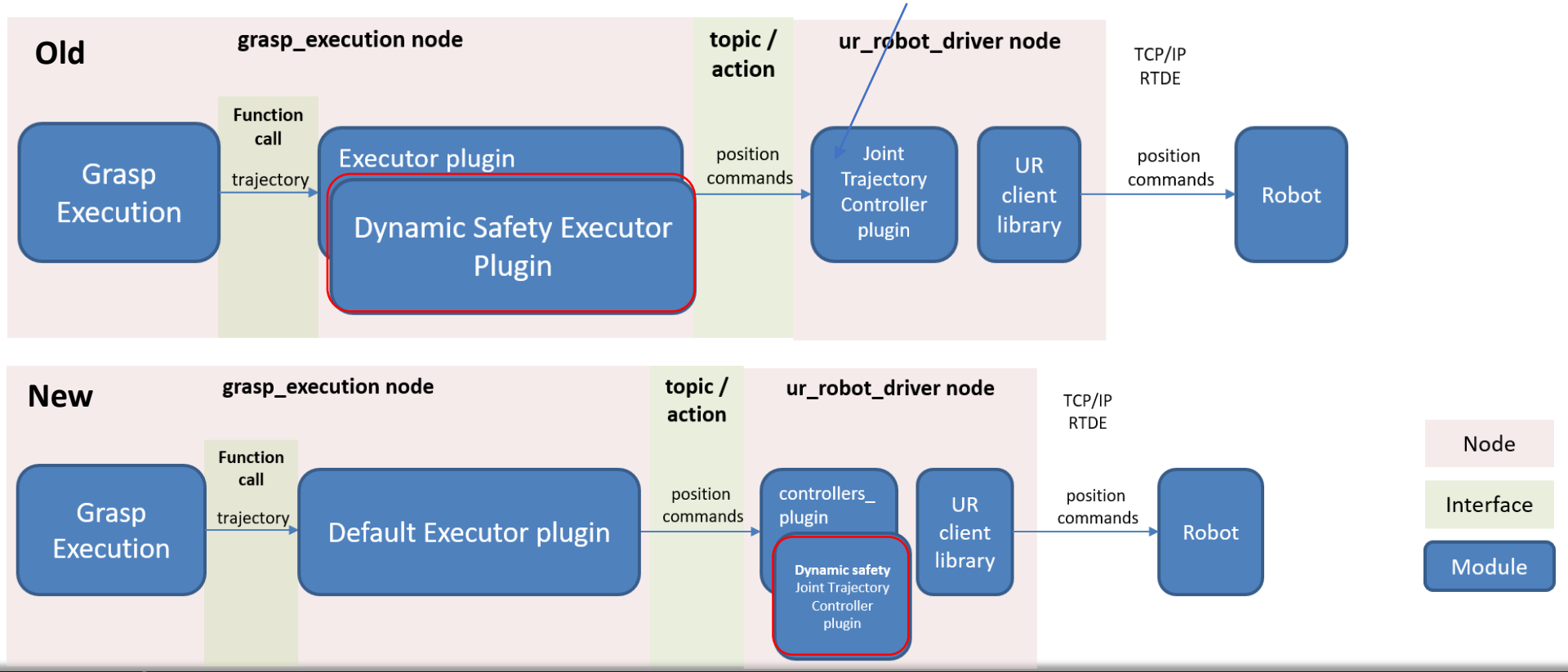
```
"actions" : ["pick_glass", "place_glass", "flip_glass", "place_glass_upright"],
```

```
"pick_glass" : {
  "action_type" : "move",
  "frame_id" : "world",
  "position":{
    "x": -0.03,
    "y": 0.8,
    "z": 0.508125
  },
  "orientation":{
    "x": -0.999999,
    "y": 0.000398986,
    "z": -0.000398903,
    "w": 0.00119512
  }
},
```

EMD Dynamic Safety Improvements

Dynamic Safety plugin loading type

- Changing of Plugin from a Grasp Executor Interface Plugin to a ROS2 Controller Plugin
- Easier interface in switching between dynamic safety and normal application.



EMD Dynamic Safety Improvements

Easy migration from standard MoveIt! implementation to dynamic safety.

Standard MoveIt! controller_manager parameters

```yaml
controller_manager:
  ros__parameters:
    update_rate: 500  # Hz

    joint_state_broadcaster:
      type: joint_state_broadcaster/JointStateBroadcaster

    pos_joint_traj_controller:
      type: joint_trajectory_controller/JointTrajectoryController

pos_joint_traj_controller:
  ros__parameters:
    joints:
      - ur3e_shoulder_pan_joint
      - ur3e_shoulder_lift_joint
      - ur3e_elbow_joint
      - ur3e_wrist_1_joint
      - ur3e_wrist_2_joint
      - ur3e_wrist_3_joint
    constraints:
      goal_time: 0.6
      stopped_velocity_tolerance: 0.07
```

No Dynamic Safety

Dynamic Safety controller_manager parameters

```yaml
controller_manager:
  ros__parameters:
    update_rate: 500  # Hz

    joint_state_broadcaster:
      type: joint_state_broadcaster/JointStateBroadcaster

    pos_joint_traj_controller:
      type: emd_dynamic_safety/DynamicSafetyTrajectoryController
pos_joint_traj_controller:
  ros__parameters:
    joints:
      - ur3e_shoulder_pan_joint
      - ur3e_shoulder_lift_joint
      - ur3e_elbow_joint
      - ur3e_wrist_1_joint
      - ur3e_wrist_2_joint
      - ur3e_wrist_3_joint
    constraints:
      goal_time: 0.6
      stopped_velocity_tolerance: 0.07

    dynamic_safety:
      dynamic_parameterization: true
      use_description_server: true
      description_server: /rviz2
      environment_joint_states_topic: "/joint_states"
      ...
```

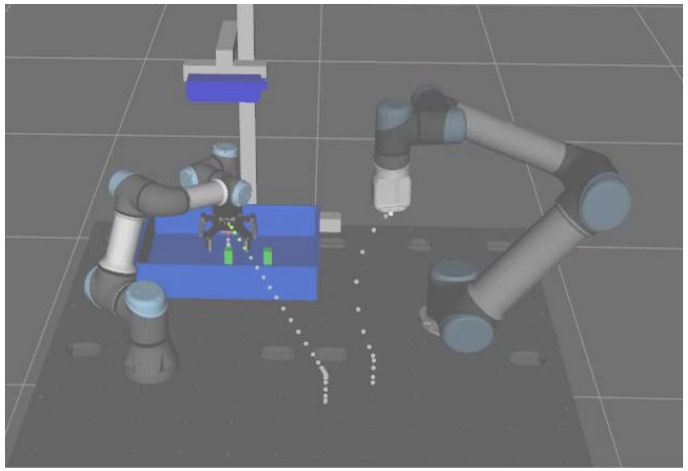
With Dynamic Safety

EMD Dynamic Safety Improvements

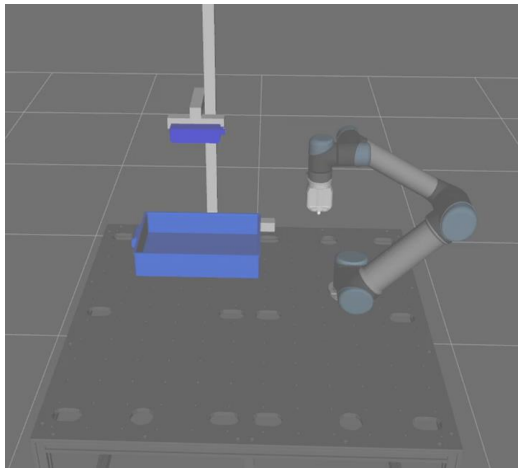
Types of Collision types supported by Dynamic Safety

- Joint encoder (i.e. another robot)
- Basic shape and meshes
- Octomap (Pointcloud)

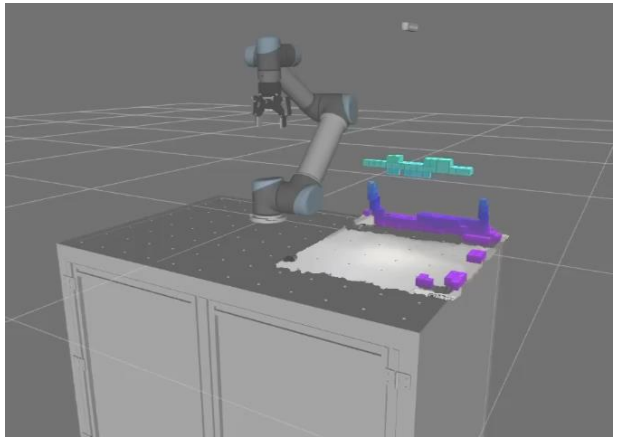
Another Robot



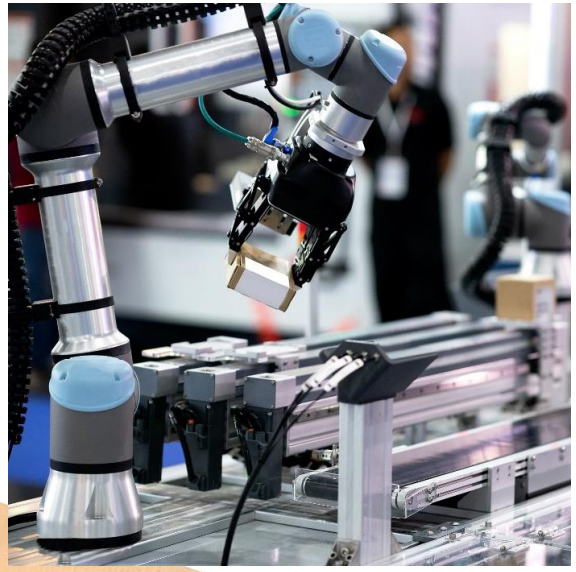
Basic Shape



Octomap



Industrial Use Case: Packing and Unpacking of Products



Problem Statement

FMCG company is looking for a fully automated solution to unpack, label and pack commodities products from and into a shipping case

The Solution

- Using ROS2 EMD and EPD together with our industry partner to co-developed an end-to-end system which can unpack, label and repack
- A Shopfloor Control System that controls and orchestrate the hardware communications thru PLCs and MES system

The Challenges

- Error margin and inconsistency in ground truth detection – EPD improvement and hardware limitation
- Further enhancement and stability on the ROS2 platform will be required

Project Significance

- ROS provide the opportunity for the industrial company to scale without lock-ins
- Able to support more than 22 different picking objects, each with its unique configurations
- A modular and adaptable system was established to automate the entire production system and eventually be ready for operational deployment in future

Other Industrial Use Cases

Industrial Use Case: Flexible Bin Picking

Johnson&Johnson

Problem Statement

Johnson & Johnson wants to automate the picking of J&J products from Vertical Lift Modules (VLM) for faster order fulfilment

The Solution

With the use of ROS modules /packages such as Navigation, Moveit and YOLO to develop the solution

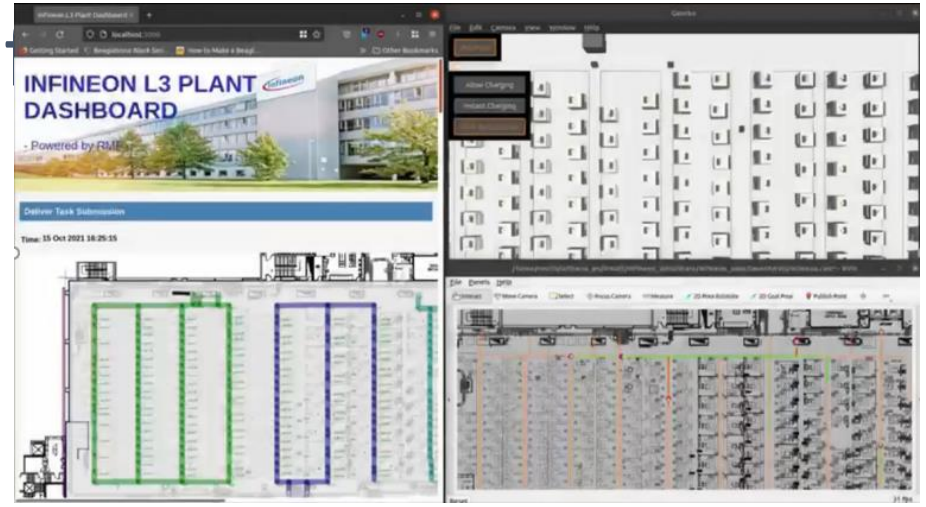
The Challenges

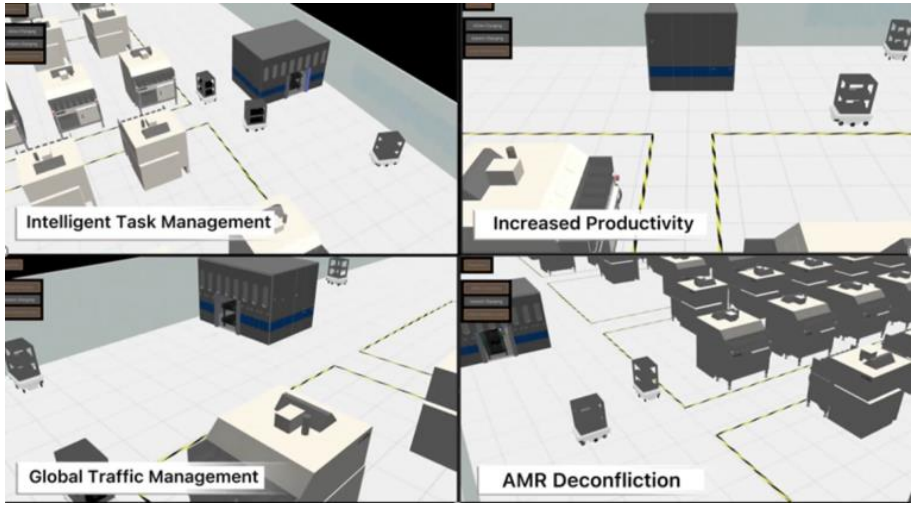
- Navigation stack inaccuracy by robot has to be corrected by vision
- It would be challenging to onboarding 10K SKUs in future

Project Significance

- A Minimum Viable Product (MVP) solution was derived
- Bin picking productivity increases by 35-65% compared to manual picking – faster order fulfilment
- Full implementation planned for 2023

Industrial Use Case: RMF Simulation for Production





Problem Statement

Infineon Technologies Asia Pacific wants to develop a Robotic Middleware Framework (RMF) simulation to understand the production readiness needs if they are to embark on a fully autonomous manufacturing solution

The Solution

Using RMF fleet management simulating in Gazebo and creating a web user interface for task management and dashboard monitoring

The Challenges

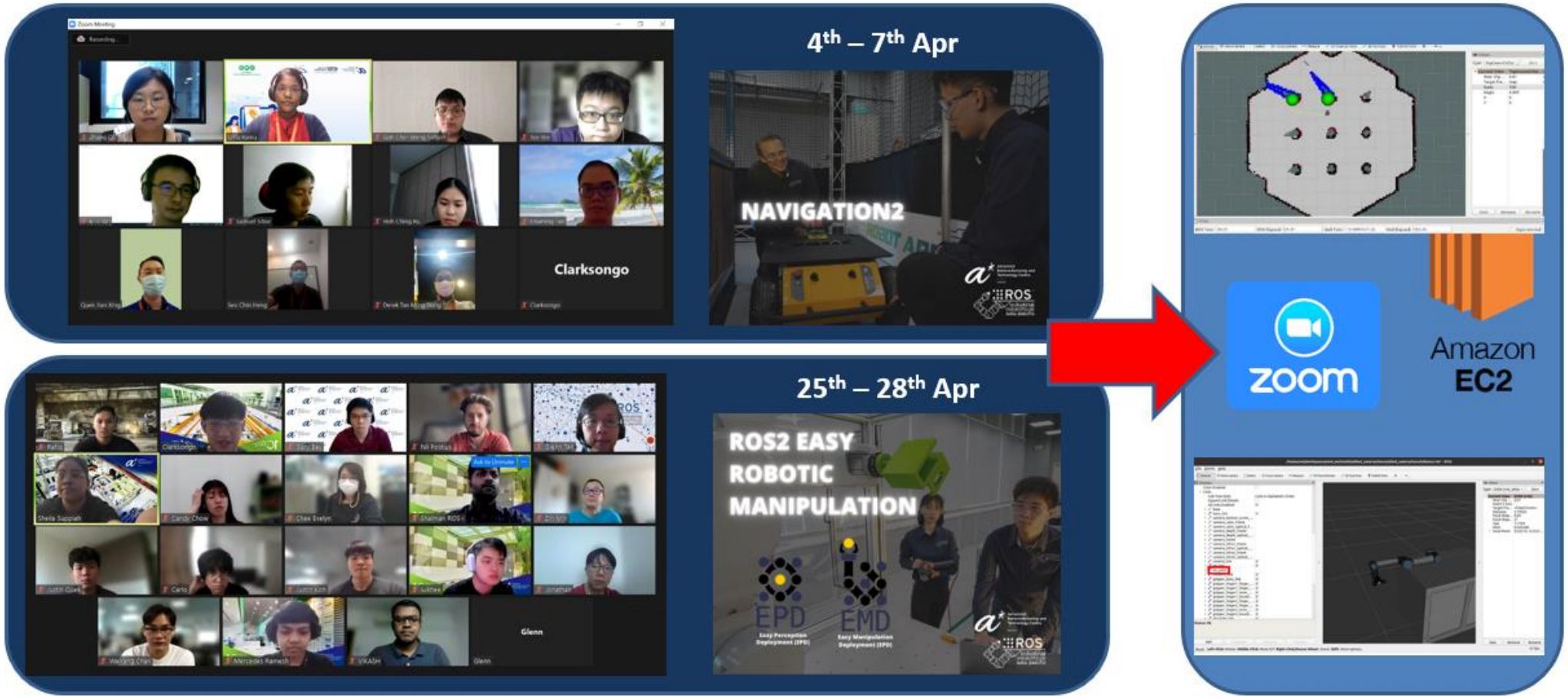
- Some of the simulation assets were not available, and the team had to build them from scratch for a more realistic simulation

Project Significance

- Successful development of digital twin for Infineon factory shopfloor
- Served as a platform study for scalability toward actual implementation in the future

ROS Industrial Training Update

ROS2 Navigation and Easy Robotic Manipulation Trainings



Upcoming ROS Industrial AP Trainings

29th Aug to 1st Sept 2022

Scan here to register!

26th to 29th Sept 2022

Scan here to register!

Thank you!

ROS-Industrial Asia Pacific
Email: ros-i_asia@artc.a-star.edu.sg
Website: rosindustrial.org