Advanced Remanufacturing and Technology Centre
ARTC

ADVANCED PERCEPTION

easy_perception_deployment **ROS2** package

Bey Hao Yun
Research Engineer, ROS-Industrial Consortium Asia Pacific

ARTC

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What is **easy_perception_deployment**?

A **ROS2** package that accelerates the training and deployment of custom-trained Computer Vision model for industries.

The package will be **formally tested**.

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Why **use** it?

- Permissively licensed and **open-sourced**.
- Reduces time needed in **training and deploying** robotic vision systems.
- Reduces **knowledge barrier** with the use of GUI to guide users. **Targeted at users with no programming background.**
- Relies on **open-standard ONNX** AI models. **Removes overreliance** on any one given Machine Learning library (Eg. Tensorflow, PyTorch, MXNet).

Training To Deployment [1/2]

To **train** a model for custom object detection, a user need only prepare **inputs**:

1. .jpgs/**.png**s Image Dataset of custom objects

(Approximately 30 images for each object)

2. .txt Class Labels List

The expected **output** will be:

1. .onnx trained AI model

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Training To Deployment [2/2]

To **deploy** a model for custom object detection, a user need only prepare inputs:

1. .onnx trained AI model

2. .txt Class Labels List

The expected output will be:

2

1. A ROS2 package that runs inference using the model and classifies images provided by a video stream from a camera.

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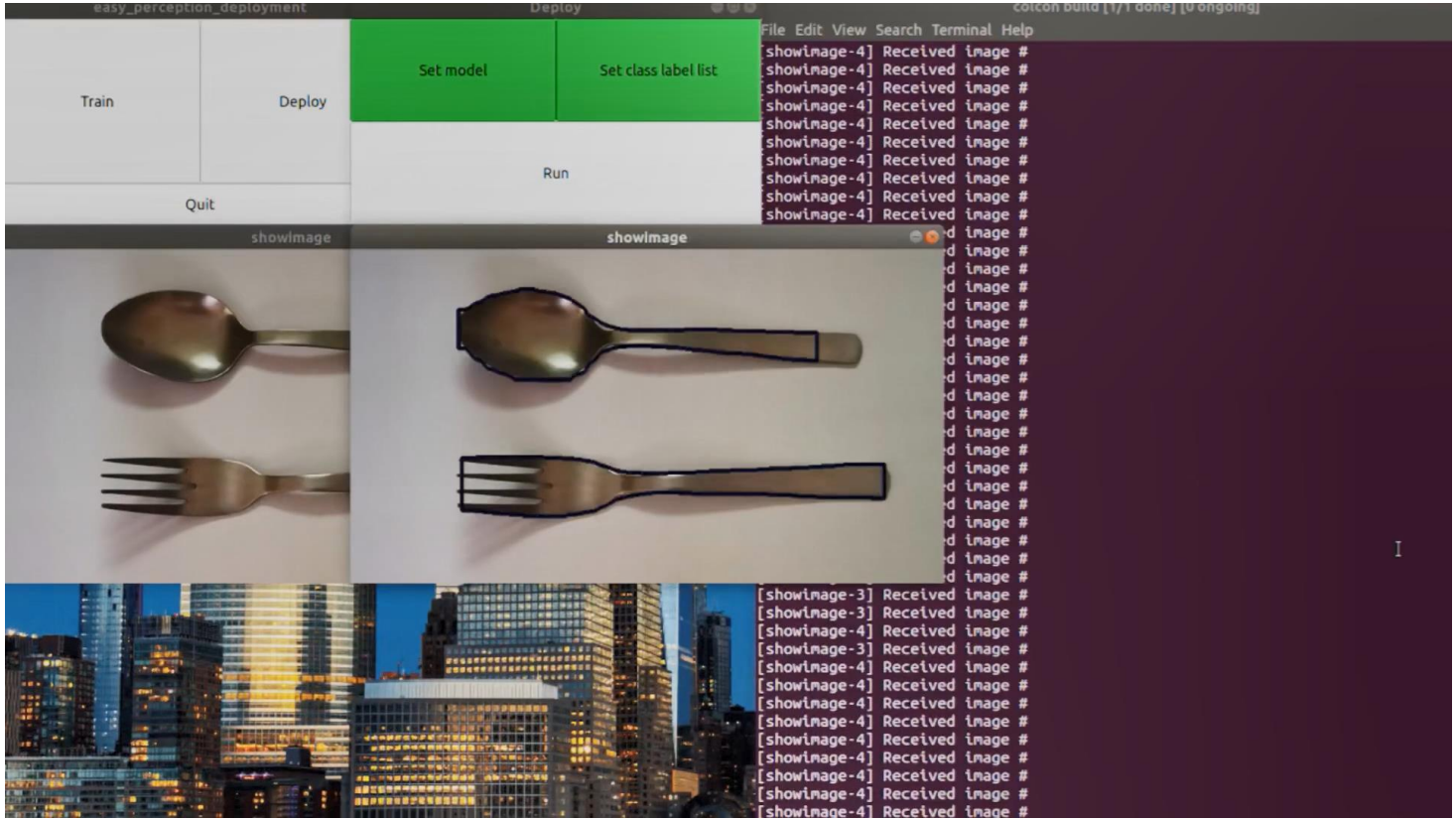
Alpha Release [1/3]

Use Case	Identifying forks and spoons
Rationale	• Demonstrate **high-fidelity discerning capabilities of AI models** for similar-looking shiny objects. • Demonstrate using objects which are **similar to typical metal-based industrial components** along an assembly line. • Demonstrate flow of training to deployment, **applying the earlier flow into real-world practice**.

Alpha Release [2/3]



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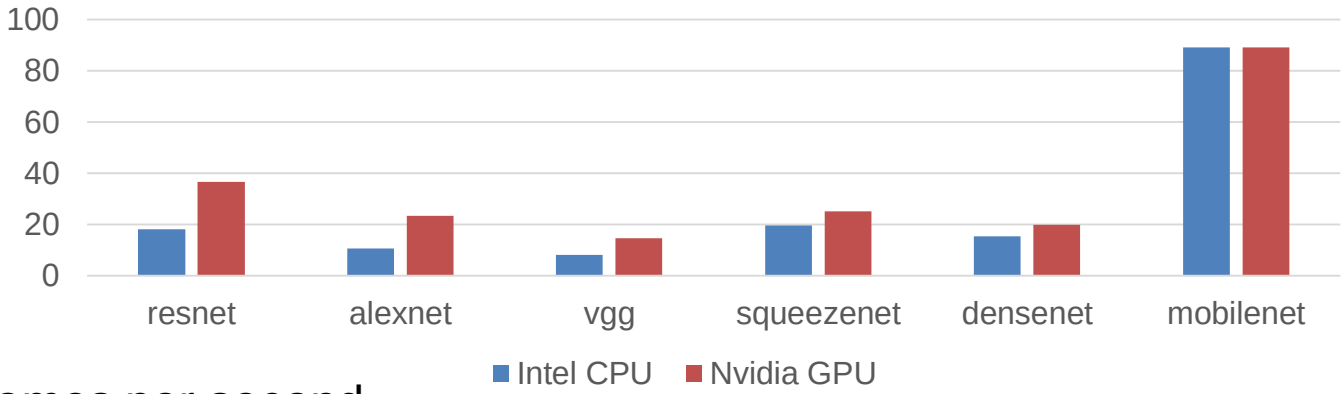
Alpha Release [3/3]

Below is **a speed benchmark** using various interchangeably **Precision Level 1 models** provided by **PyTorch** Model Zoo, using a Nvidia Quadro M1200 GPU and an Intel i7 -6700 CPU.

But why are we providing a wide array of different models to choose from? See next slide.



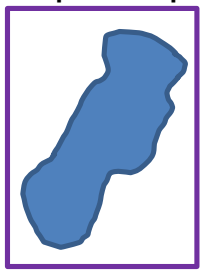
In frames per second

Main Axes Determination [1/2]

Extending P3 Perception output, early work has started for Milestone 2: Object Localization; Converting **Perception** outputs to **Manipulation** inputs.

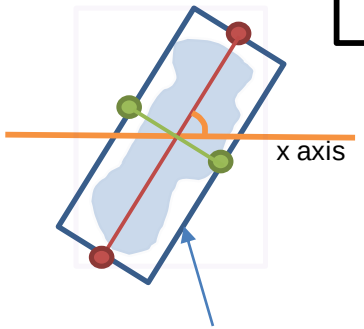
3D PointCloud
[Captured using **Intel Realsense D415 Stereo Camera**]

Perception outputs



Get **Rotated_rect** with the use of **Opencv**.

Rotated_rect



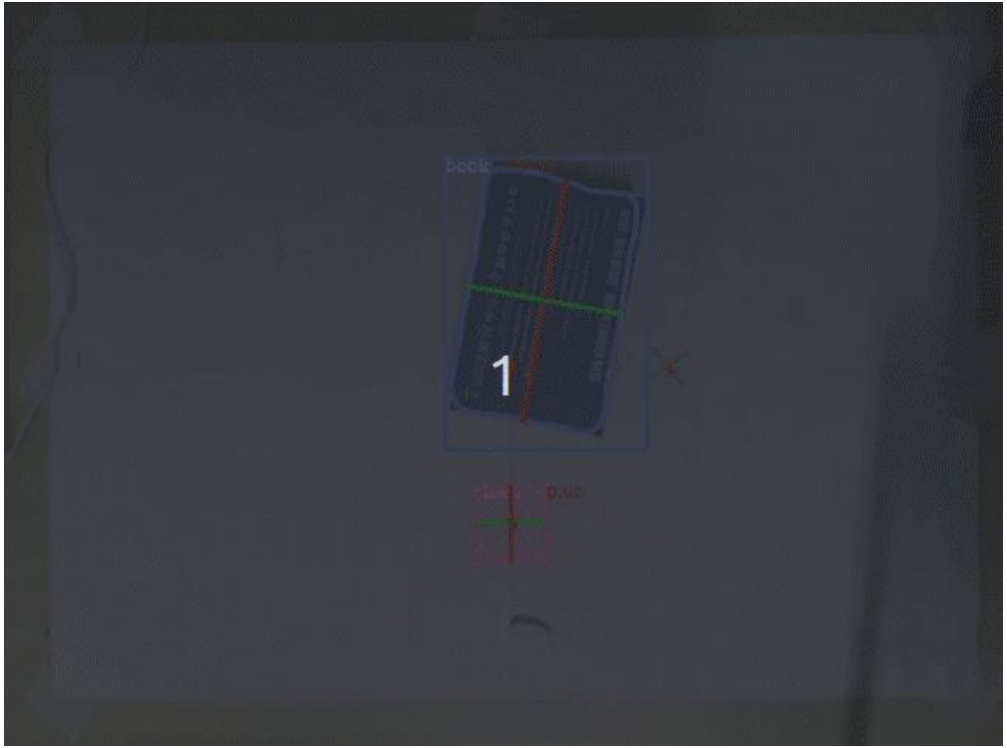
Manipulation Inputs

Input Names	How it's derived
Length (L), Breadth (B), Height (H) of Object	• L,B - Pixel difference between **red dots** and **green dots** (Rotated_rect). • H – Take distance from camera to Object center (PointCloud).
Orientation of Object	• Angular difference between Major axis (**red line**) and X Axis (**orange line**) (Rotated_rect)
3D Centroid (xyz) Of Object	• Use cam intrinsics, Object center and distance of Object center from cam (Rotated_rect, PointCloud).

This allows ease of integration between WP 1.1 (Perception) and WP 1.2 (Manipulation).

Main Axes Determination [2/2]

See Perception output in action.



Where to find it?

The Alpha release will be accessible **soon**.

It can be found on the official **ROS-Industrial** GitHub repository.

https://github.com/ros-industrial/easy_perception_deployment

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Contact us

Bey Hao Yun
Research Engineer
ARTC, ROS-Industrial Consortium Asia Pacific
beyhy@artc.a-star.edu.sg

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THANK YOU

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A New Way to Monitor Robot Diagnostics

@ ROS-I Developers Meeting 08/09/2020

Outline

- Intro
- Open Source Remote Diagnostics Solution
- How does it work?
- Demo!
- Resources
- Call to Action!
- Questions?

COGNICEPT

Keep your robots going.

About us

Technology Company that builds tools and services to assist in better Human Robot Interactions at workplace

Technology :- Cognicept Agents + Remote Intervention Protocol + Error/Resolutions Database + Web/Desktop Tools

Services :- Operations team across Singapore and India - > 10,000 successful interventions in one year.

Do robotics companies track errors?

From the Error Conditions and Task Resolution Working Group...

1. Does your organization keep track of the common errors occurring in the developed robotic solution?

Total Responses: 11

Yes: 6

No: 4

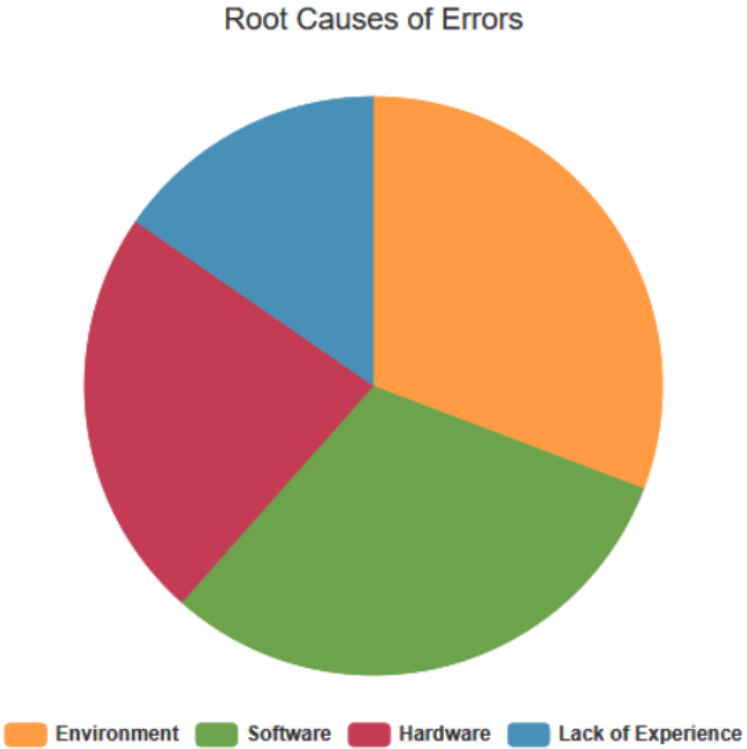
Not Applicable:1

What are some of the root causes for robot errors?

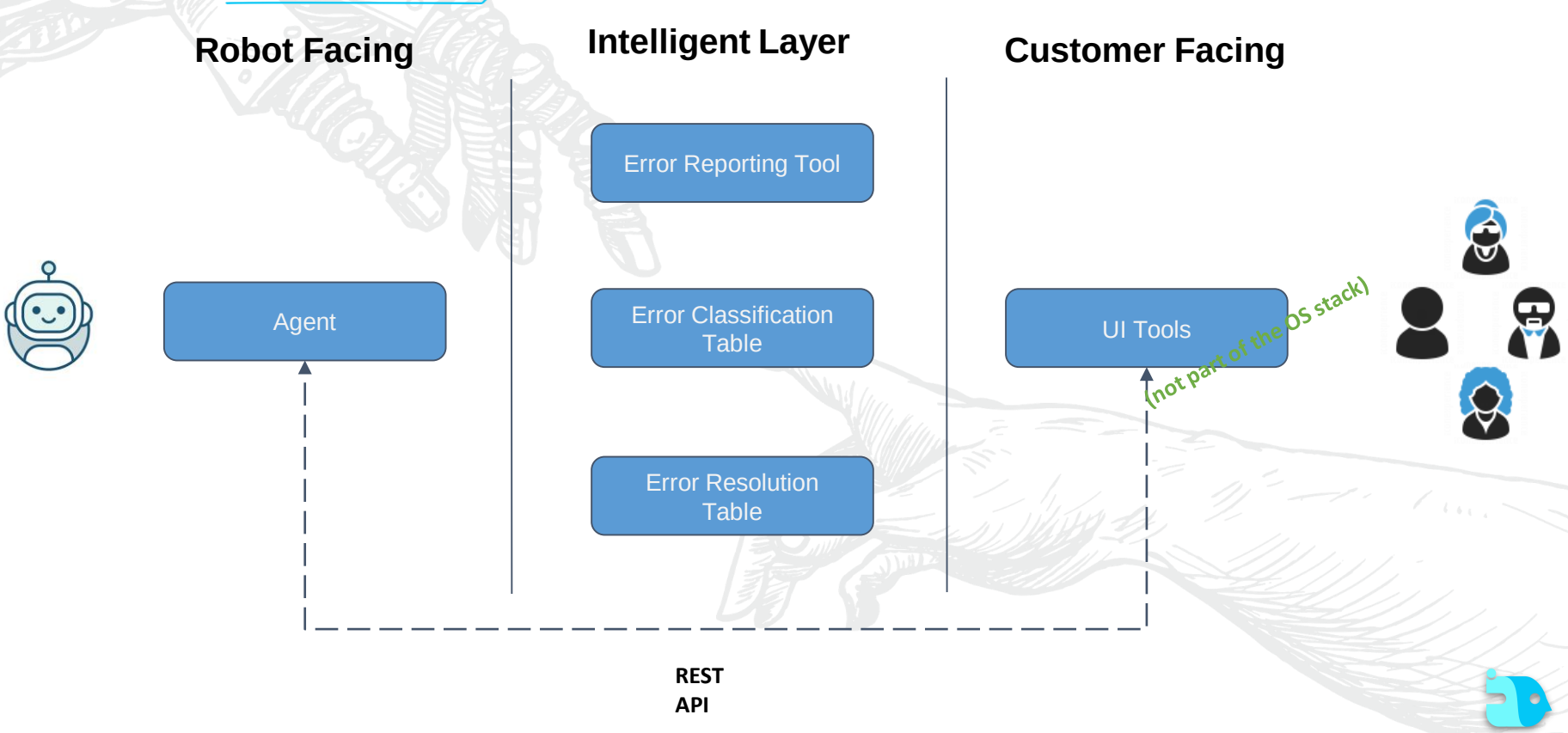
From the Error Conditions and Task Resolution Working Group...

2. Why do you think such errors occur? Kindly elaborate on the root cause of such errors.

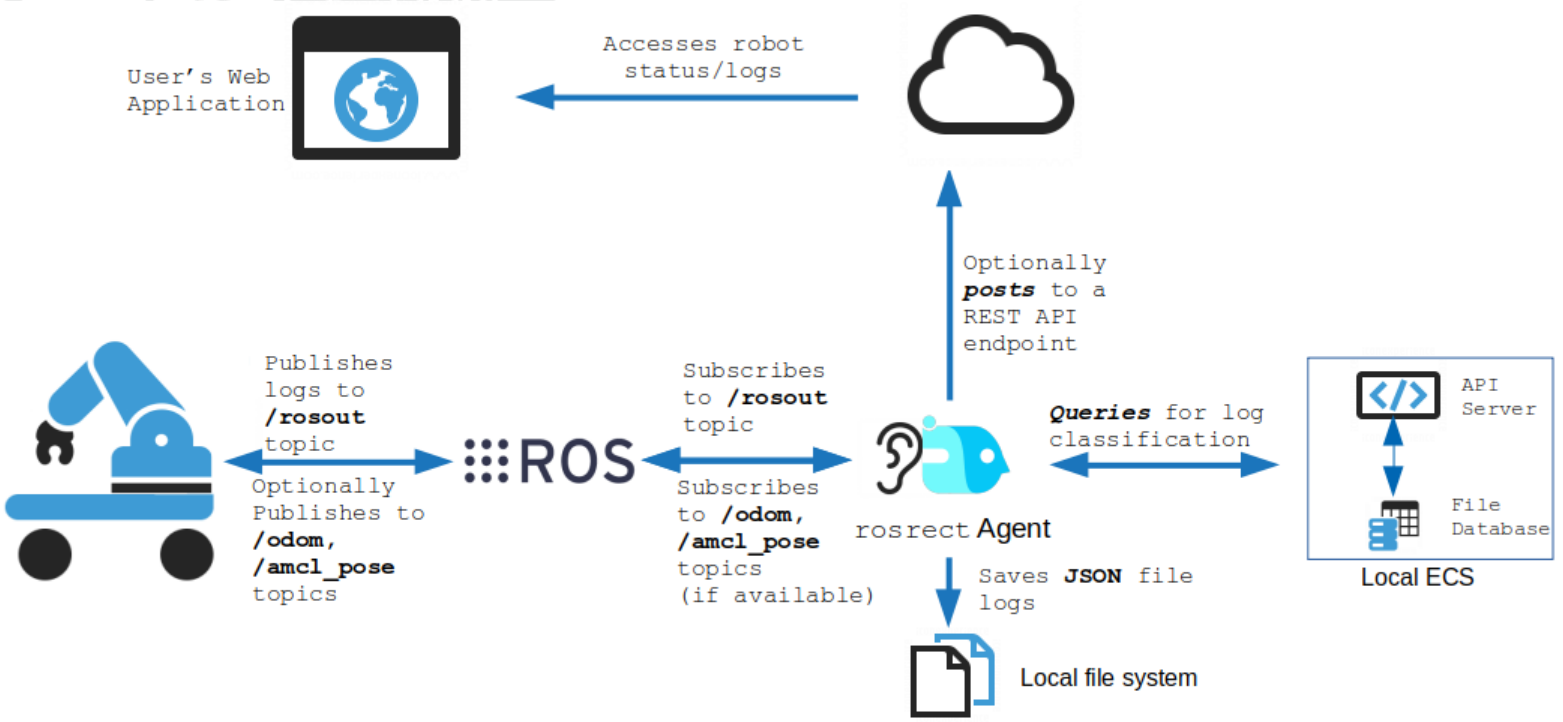
Total Responses: 10



Open Source Remote Diagnostics Solution



How does it work? Part 1: The Agent



Demo Time!

Message Structure

rosgraph_msgs/Log

```
byte DEBUG=1
byte INFO=2
byte WARN=4
byte ERROR=8
byte FATAL=16
std_msgs/Header header
byte level
string name
string msg
string file
string function
uint32 line
string[] topics
```

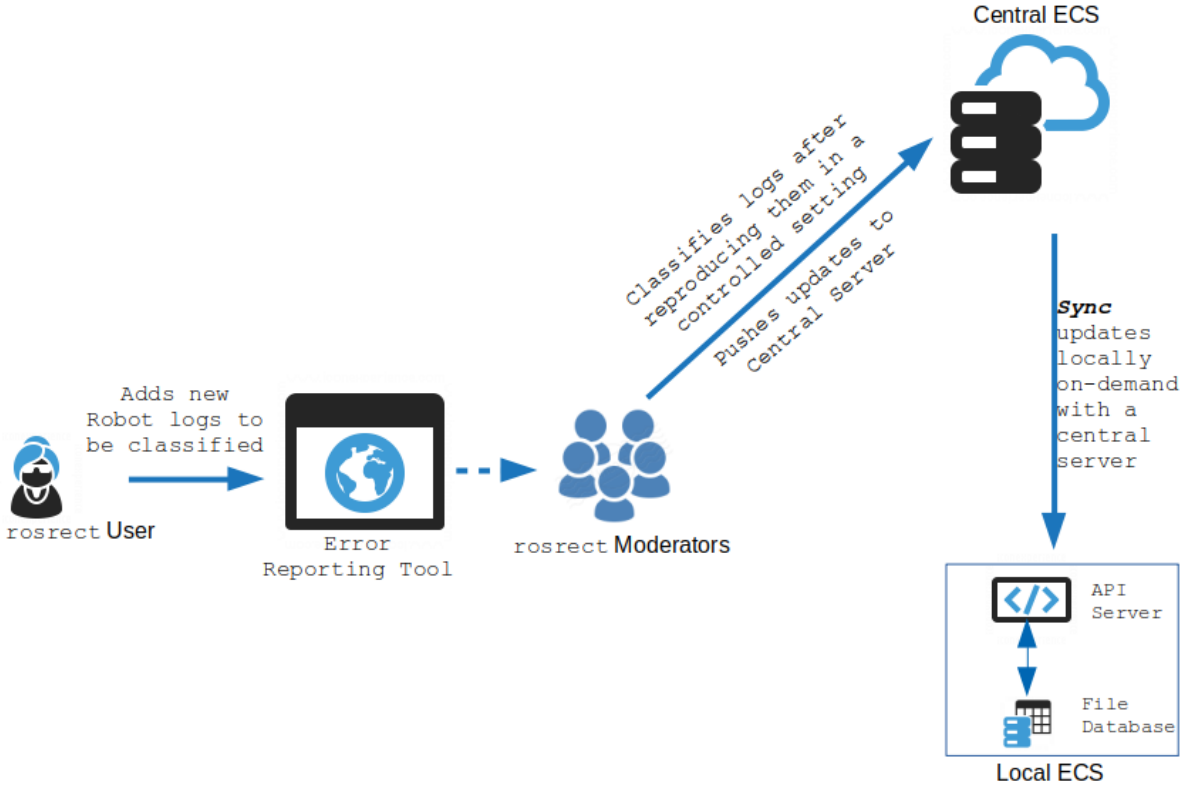
Agent JSON


```
        "agent_id": "Undefined",
        "compounding": "Null",
        "create_ticket": false,
        "description": "Null",
        "event_id": "Null",
        "level": "Heartbeat",
        "message": "Online",
        "module": "Status",
        "property_id":
"Undefined",
        "resolution": "Null",
        "robot_id": "Undefined",
        "source": "Null",
"telemetry": {
        "nav_pose": {
        "orientation": {
                "w": 1,
                "x": 0,
                "y": 0,
                "z": 0
        },
        "position": {
                "x": 0,
                "y": 0,
                "z": 0
        }
        },
        "odom_pose": {}
        },
        "timestamp": "2020-07-
07T07:16:12.233268"
```

Agent Features

- ✓ ROS 1 and ROS 2 supported
- ✓ ROS mode to directly catch generated Errors/Metrics from ROS network
- ✓ ECS mode to additionally query Error Classification for generated Errors/Metrics from ROS network for standardized reporting
- ✓ Session logging to store generated logs in unique folders identified by UUIDs
- ✓ Event handling and Tagging for sequence of logs using UUIDs
- ✓ Agent / Site / Robot ID tagging using UUIDs
- ✓ JSON logs
- ✓ State handling for compounding and non-compounding error
- ✓ Configurable POST API to connect to REST endpoints to push JSON to downstream systems
- ✓ Heartbeat signals to keep track of robot status periodically
- ✓ Telemetry info available in logs to log robot position at the time of log generation
- ✓ Dockerization and dependency minimization

How does it work? Part 2: The ECS



Demo Time!

Resources

Agents :

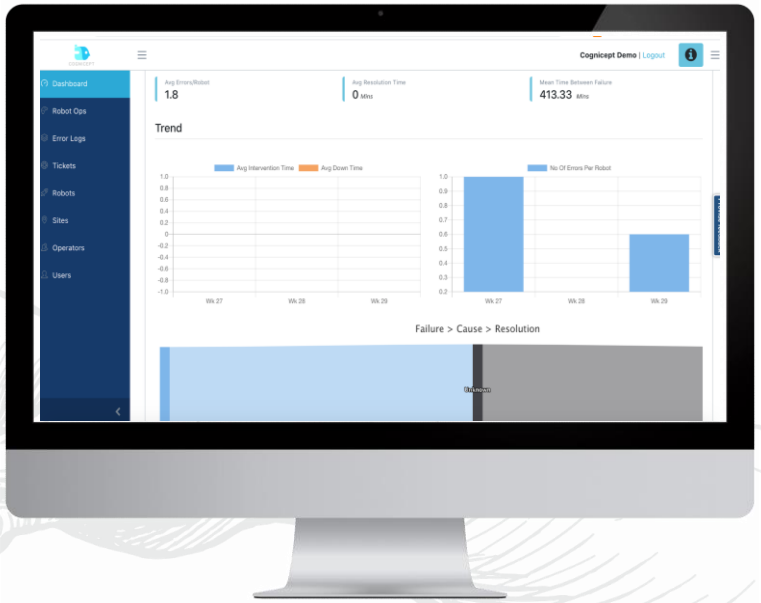
- ROS 1 : https://github.com/cognicept-admin/rosrect-listener-agent
- ROS 2 : https://github.com/cognicept-admin/rosrect-listener-agent-ros2

ECS:

- API Server : https://github.com/cognicept-admin/rosrect-ecs-api-server
- Error Reporting Tool (***alpha version*** ;)) : https://ert.cognicept.systems/

Cognicept's Solution

CRISP - Cognicept Remote Intervention and Security Platform



Web tools designed to support :

- Incident Management/ Diagnostics
- Remote Intervention Using Web Tools
- Site level Fleet Monitoring
- Visualisation of Robots, Pointcloud, Camera
- Navigation, Teleop, Localisation Goals
- Communication with internal team/clients
- Analytics/Dashboard

Call to Action!

- Try the agents
  - Easy to start with any Gazebo simulation (like this demo)!
  - We are really looking for feedback from running it with real robots and their extended use cases. We have successfully run and tested it with a few robot platforms

- Explore the ECS database
  - Let us know if the existing information is interesting. Would you like something added for your use case?
  - Do you have a robot you have access to? Help us classify these errors by sharing the diagnostic details with us
  - Contact us if you are interested in the ECS moderators community

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at:
https://app.cognicept.systems/register

Questions/Discussion

ROBOTS AND HUMANS WORKING TOGETHER FOR A BETTER FUTURE

info@cognicept.systems

Singapore Bangalore