Cloud Robotics Working Group Meeting Minutes

Links

ROS Discourse Community Group Google Calendar
Cloud Robotics WG Doc Folder
Guest Speaker Signup Sheet
WG Contact Sheet
Initial Structure for Gathering Data

2024-06-17

Q&A with Gui Manzato (Ekumen):

- At what fleet size do you see people starting to use the cloud?
    - ~100
- Use-cases for cloud robotics? (open-ended then prompt with list in survey)
    - fleet management is the main thing
    - keep fleet up to date
    - monitoring fleets
        - keep up with what's going one
        - even harder with 1000s of robots
        - errors (hardware or software), regressions
        - predict failures before they happen
            - similar to automotives: trying to estimate mean-time-between-failure (MTBF)
        - need very precise information, keep track robot parts being changed
        - tech: most people start from scratch build their own
            - even though there are lots of tools
            - often think it's a "small thing"; keep growing
    - simulation/recording/playback
        - rosbags are good, but too big
        - most companies build their own information packages to record and replicate
            - no standard beyond ROS or in the cloud
    - three large companies that don't use ROS
        - repeated simulation, rosbags, etc.
    - OTA:
        - always starts too late
        - small startups often ignore this too long

        - need to know which version is installed on a robot
        - code not version (some just git pull on the robot)
        - packaging:
            - A/B partition is most reliable; but consumes a lot of data (compared to deb packages)
            - docker: not really (at least not on the robot)
    - kubernetes:
        - lots in the cloud, but not on the robot
        - can be overkill
    - meta-question: do you upstream solutions?
        - e.g., configuration management, snowflake-management (unique cases)
    - simulation:
        - Q: do your customers ask for it as a first-class application? simulation of business use-case, for instance simulate changes to factory; put that in the hands of the customer?
            - A: not seen that much; but seen specific simulations of business (ROI)
                - many end-users are not very technical
        - Q: in ports, sold more simulations than actual automated container solutions more ready to share fleet manager; technically savvy
            - other side of the spectrum: RaaS that add robots to a not yet automated system
            - how many points on that spectrum do you see?
                - A: mostly see RaaS, e.g., Savioke: hotel managers not very technical savvy
- Technology stack?
    - networking
        - not very uniform
        - some customers have very good wifi
        - some are mostly offline
        - architecture? designated networks for robots? piggy-backing on existing networks?
            - piggy-backing: hard, because it creates friction for installation and adoption; bad idea
            - better to rely on your own infrastructure
                - some warehouses you have full control
    - communication, robot<>cloud, cloud<>web, robot<>web
        - ROS between robot and cloud?
            - it usually stops at the robot
            - How clear is that to companies? should it be more clear that ROS is really not meant for the cloud?
            - message types should be compatible with the cloud, but the ROS communication protocol is not appropriate
        - robot<>cloud:

                - usually custom some use MQTT, REST
                    - use of MQTT varies (large and small messages)
                - rosbridge is falling out of favor
                    - very slow
                    - much slower than rosnodejs/rclnodejs
    - front-end/UI
        - again very custom, mostly based on React
        - not much traction for third-party software/components
            - many build their own components again on mapbox
            - esp. in fleet management
            - perhaps because companies think of it as a core business function
    - How to manage updates on robot without downtime without micro-services (ties back to question about kubernetes)?
        - we do typically take a robot down for updates
        - Q: what about safety (re. updates), where is it going?
            - A: yes, critical, one of the reasons for taking it down for updates, testing after update

2024-05-20

- Attendees: Hans Christian Woithe, Christian Fritz, John Miller, Phil Roan, Giovanni Toffetti
- Topic: Survey results
- Will publish call for more surveys on ROS discourse & Linked in
- updated Information Gathering for Cloud Robotics WG
- Format will be
    - 1 statement/question to get attention
    - An interesting picture
    - 3 to 5 bullet points.
- Action items
    - Christian type up rough draft for us to finish polishing over email

2024-05-06

- Goals
    - Something we can publish as results to the community
    - Start living document that says this is the state and what we need to improve
- Reviewed the 22 survey responses
  Cloud Robotics Working Group - State of Cloud Robotics Survey (Responses)
- Categorized text responses
- Started Analysis Information Gathering for Cloud Robotics WG
- Engaging conversations
    - Issues experienced relate to deployment size
    - How do we get more responses from large deployments?

    - Was survey long enough?
    - Cloud robotics shouldn't be just ROS
- Detailed notes Cloud Robotics WG 2024-05-06

2024-04-22

- Discussed and polished survey questionnaire
- Decided to post it on ROS Discourse, share on LinkedIn

2024-04-08

Agenda

1. How we record and analyze data on cloud robotics
2. Volunteers for creating initial versions of the database/analysis pages
3. Volunteers for adding our current basic structure to the database page
4. Ideas for how we can gather the most data going forwards - for example:
    1. Invite guest speakers to also be interviewed by the group
    2. Contact other cloud robotics companies to request speakers/interviewees
    3. Build questionnaire that can be made public for anyone to fill out

Minutes

- Chaired by Michael
- Introductions from new group members
- Discussed agenda
- Agreed to start with the gathering data point (point 4) before proceeding to the other agenda items
- Decided public questionnaire with a few questions would be a good way to collect data from the public
- Started Google doc to collaborate: https://docs.google.com/document/d/1U7qbR1slb51r5iwK3Y2INGKuzLcHvu5QemxUvPdfCWg/edit
- Survey in good shape, with further refining to be accomplished next session
- ROS in Netherlands discussed so group members are aware. Possibility of releasing questionnaire in time to promote at that event.

2024-03-25

Agenda (all times UTC)

17:00 – 17:05: Introduction by Christian Fritz (chairing for Michael)
17:05 – 17:20: Introduction of new attendees as we cover Data Collection phase questionnaire
17:20 – 17:55: “What role does cloud play in robotics”
17:55 – 18:00: Discussion of Kubernetes in robotics

Minutes

- “What role does the cloud play in robotics?”
    - Development
        - Storage of training data → moved data in-house because of cloud costs
        - Simulation, including large Monte Carlo runs
        - Regression testing
        - Hardware-in-the-loop
        - Test orchestration
        - Use to reduce build/prototyping time: e.g. having Nav2 running in a cloud instance and stream data from a mobile device ← shifting compute and robotics algorithms in the cloud
        - Collaboration (across organizations) and data ownership
        - Split code base i.e. cloud native parts will be different from robot-native parts, plus microservices don’t all need to get refreshed at the same time
    - Production
        - Fleet management
        - Off-boarding robotics algorithms
        - Performance monitoring, e.g. how many navigation goals succeed vs. fail
        - Observability
        - Teleoperation
        - Continuous deployment / over-the-air updates
        - Customer data collection and dashboards and reports (and GDPR impacts)
- How to design cloud APIs so they can be easily shared and deployed (and deployed to different
- Resources and Tools
    - Cloud robotics providers: rapyuta.io, Amazon SageMaker
    - Learnings from CNNF and similar technologies
- Challenges
    - Multi-vendor problems / cross-vendor patterns
    - Great to get started, great to learn, but can be challenging in production / scaling
    - Digital security concerns
    - Differential permissions
    - Infrastructure resource management (e.g. who gets priority on calling the elevator)
    - Cost
    - Communication
- Who should we invite to speak on these topics?
    - Customer or Product Owner perspectives?

    - John Archer to reach out to a fleet of fleet manager
    - Waymo?
    - https://www.edb.gov.sg/en/our-industries/company-highlights/centre-for-healthcare-assistive-and-robotics-technologies.html
- Discussion of Kubernetes and robots

2024-03-11

Agenda (all times UTC)

17:00 – 17:05: Topic Collection (none), Introduction
17:02 – 17:12: Long-term strategy proposal from Michael Hart
17:12 – 17:52: Long-term strategy discussion
17:53 – 17:57: How do we get started/plan for next meeting

Minutes

- Recording to be posted on ROS Discourse/YouTube
- Long-term strategy proposal from Michael Hart
    - What is Cloud Robotics?
    - Tenets:
        - Not just for cloud roboticists
        - Open
        - Transparent: posted on ROS Discourse
    - Phases
        - Data Collection: what's easy/hard about cloud robotics; why aren't people doing it more and how are we helping them do that?
        - Data Analysis: collect builders, consumers, and technology categories together; build plan/roadmap
        - Build & Scale Up
- Slides: https://1drv.ms/p/c/ac57cb35e99321d9/ETYGWAdn4mtFqE1uM30cdN8BnjzLj_5_ebD_s3VYIiYt7w?e=gQlaAS
- Discussion
    - Christian Fritz: no agreed definition of "Cloud Robotics"
        - Offload/augment compute, e.g. UC Berkeley's "FogROS"
        - Fleet management, web tools
    - Benji Barash: focus on cloud robotics from a large-scale data post-processing and analysis
        - Similar to simulation: a development resource, not operational
    - Giovanni Toffetti: supporting distributed robotics applications

- Julien Enoch: how does “edge robotics” fit in? Where functions are deployed on the “edge” (not on robot) not all the way to the cloud
- Hans Christian Woithe: “network-aware robotics applications”
    - Example: when bandwidth limited, reduce number of points in point cloud
- Christian Fritz: Streaming point clouds live is painful
    - H.264 for video is a good example
    - Draco library for streaming point clouds (from Google)
- Julien Enoch: what functionalities are being offloaded, and how to interface them
    - Service calls?
    - Shape of traffic? Symmetric?
    - Latency and bandwidth limitations before algorithm fails
-
- Christian Fritz: “Build and Scale” slide
    - Where is this going?
    - Had a previous Webtools WG, but nothing really came from it
    - Identify starting points
    - If these problems are real, why has no one started working on it already? (Or what are they? Are they open source?)
    - What are our artifacts going to be?
- Michael Hart: in the vision:
    - offering to own and maintain open source tools
    - Add item to “Identify and Track tools”
- Benji Barash:
    - Improve tool discovery: identify projects that solve some of these issues
- Hans Christian Woithe:
    - A lot of knowledge in silos, e.g. why does MQTTsync work?
- Benji Barash
    - Connecting people who are experts with certain technologies
- Julien Enoch
    - A good first output would be some guidelines for newcomers
        - What is the best tool
        - What is the cost
- Michael Hart & Christian Fritz
    - Before we even begin building tools, make a space to congregate
    - Ensure this group survives, keep the community going
    - “If we just stayed in the data collection phase forever, I’d be very happy”
    - Community building is not covered in proposal so far
- Benji Barash
    - Connections lead to ontologies, which leads to tooling
    - Discoverability of good tools is a very good outcome
- Hans Christian Woithe:
    - Safety and security aspects
- Christian Fritz:
    - I work with a lot of companies start from zero when they build their stacks

        - “Rediscovering” things many of us have already learned
        - Start with 1 robot, deploy to customer, then realize “holy cow, this is running on the customer’s wifi and ros has no security”
    - Michael Hart:
        - If we start authoring projects, we need to be able to ensure security
    - Tomoya Fujita
        - We already have a ROS 2 Security WG, being led by Canonical
    - Christian Fritz:
        - Is that limited to ROS 2, or the full stack?
    - Tomoya Fujita:
        - The group used to work on ROS 2 and application layer
        - Do nothing about zero-trust network
        - I don’t know their current activities, so we should check
    - Christian Fritz:
        - Once we get to the building stage, do we extend the scope of ROS to include the cloud?
        - We should invite UC Berkeley’s FogROS people to this group
    - Hans Christian Woithe
        - A million protocol bridges
        - Anything country-specific rules or experts? Cloud regulations
    - Phil Roan
        - Careful with text so we disclaim liability
    - Benji Barash
        - Regulation knowledge base so people can look up additional info
        - Robotics spans all sorts of different regulations
    - Christian Fritz
        - We offer video streaming, clients ask, where are your TURN servers and proxies
        - Which regulatory concerns our users should stay abreast of?
        - Ex. If you do want to solve video streaming, such and such regulation could apply to you
    - Hans Christian Woithe
        - Can we get a talk on deployment models, e.g. Kubernetes

- Speaker sign-up advertising
    - https://docs.google.com/spreadsheets/d/1drBcG-CXmX8YxBZuRK8Lr3eTTfqe2p_RF_HIDw4Rj5g/edit#gid=0
    - We can invite speakers, too
- Plan for next meeting
    - Christian Fritz will lead (Michael Hart is out)
    - Post slides to ROS Discourse to a new thread with our tag to raise awareness

2024-02-26

Agenda

(all times UTC)
17:00 - 17:25: Introductions
17:25 - 17:55: Christine Fraser, Founder of Asimovo, presents “Smarter Robotic Education - Connecting Universities and teaching ROS to Cloud Computing”
17:55 - 18:00: Wrap-up

Minutes

- recording to be posted on ROS Discourse/YouTube
- introductions
    - people expressed their interests in this group
- Christine Fraser’s presentation
    - RoboDevOps platform
    - Pain points they saw:
        - Remote collaboration:
            - access to robots, incl. remote workforce
        - Iterative Simulation
            - utilize local and cloud resources
    - Cloud Computing limitations
        - web gazebo is view only
        - Rviz is not web based
    - How to create a digital twin of your robot?
        - How to enable hardware in the loop testing while utilizing cloud?
    - Asimovo working with three different Universities and via SURF in September, incl. super computer access
        - lots of tools for creating course material (e.g., projects can be pre-loaded with ROS assets)
        - students to collaborate
        - resource sharing: both cloud simulation resources, as well as physical robots
        - partnerships with hardware providers, e.g., a robot dog
    - Tools for showcasing via simulations on Asimovo
    - SaaS opening in March
- Q&A:
    - Michael Hart: biggest barriers to adoption of cloud?
        - Ludo: unfamiliar with tooling
        - Christine: many companies even struggle to go beyond hardware (e.g., to simulation); cloud computing costs, e.g., devs running too many simulations
    - Phil Roan: how to get a good model before spending a lot of cloud simulations?

        - Christine: use different simulations depending on the use-case (e.g., for showcase vs. physical simulation)
    - Christian Fritz: vision for fleet management?
        - Christine: what they currently have really resonates with universities (iterative testing, digital twin)
            - don't have fleet management tooling yet; but could build it yourself
        - Ludo:
            - fleet management not on current roadmap
            - but allow multiple robots in same simulation env; export
            - open to integrating fleet management
    - Hans Christian Woithe: how to synchronize simulations?
        - Ludo: currently solve this via version management of assets
        - Hans, clarify: resource sharing, to avoid running too many simulations one the same machine
    - Rob Woolley: how can we help your project?
        - Christine:
            - we don't want to build everything
            - want lots of collaboration
            - interested in starting a working group for building things on top of Asimovo
        - Ludo:
            - feedback on our roadmap
            - help industry: standardization of processes, e.g., best practices for using simulation
        - Christine:
            - wearing IEEE committee hat: nurture entrepreneurship in robotics
- Michael Hart
    - wrapping up, highlighting links
    - next meeting: discuss long term strategy
    - Sign up for speaker slot if interested and have a talk to give
    -