PackML
Business Analytics Dashboard

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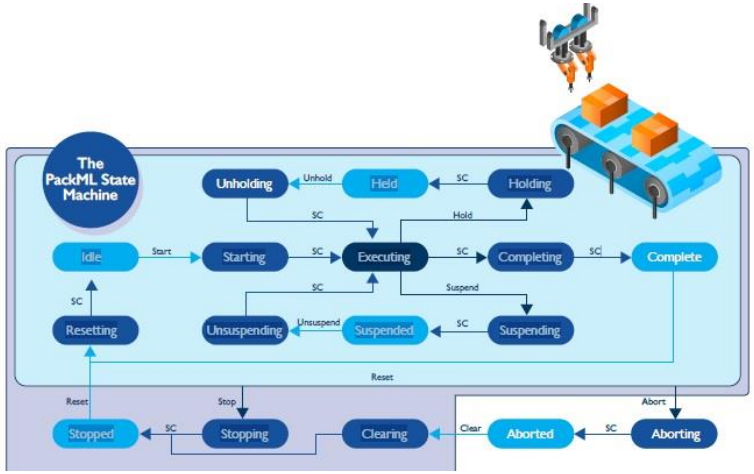
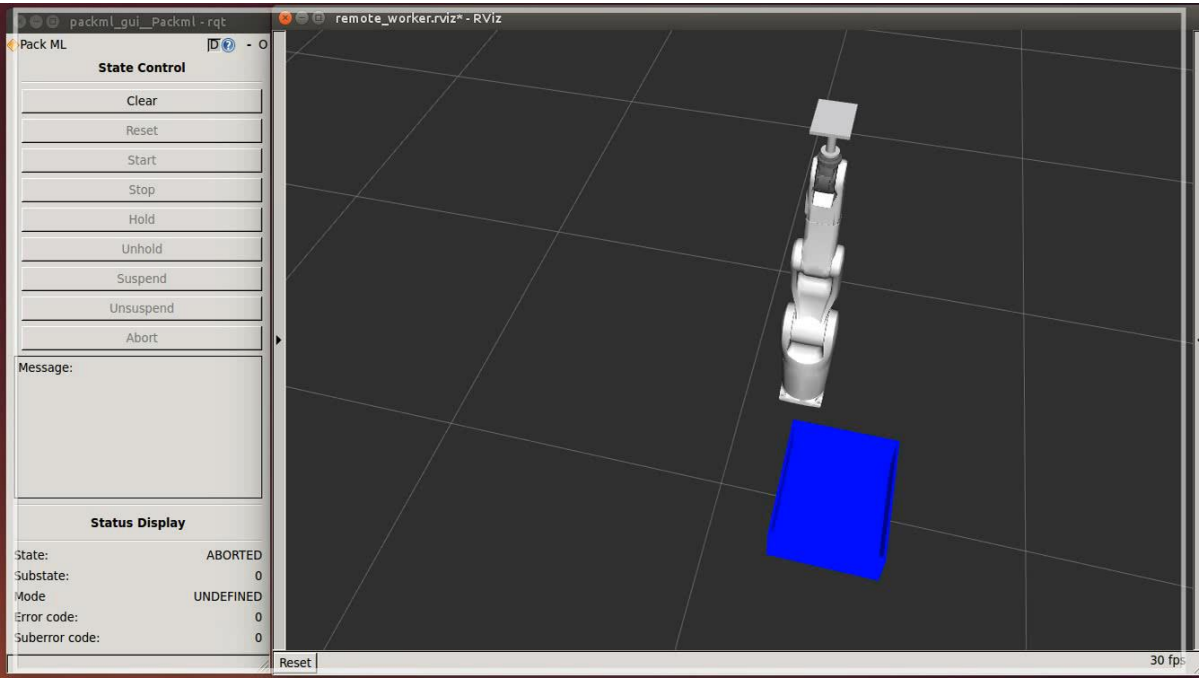
ROS-I AP Consortium: PackML

- PackML collaboration project with 3M, SwRI, ARTC, PlusOne Robotics
- **Benefits:** Ability to run ROS across multiple OEM PLCs for manufacturing plants for communication between PLCs, increased interoperability, modular and efficient
- **Current Status:**
  - **Developed** open-source C++ library (Boost) or python (SMACH)
  - **ROS as PackML Master,** Remote PLC as an equipment module



PackML (Packing Machine Language) state machine commonly used by PLCs in packaging

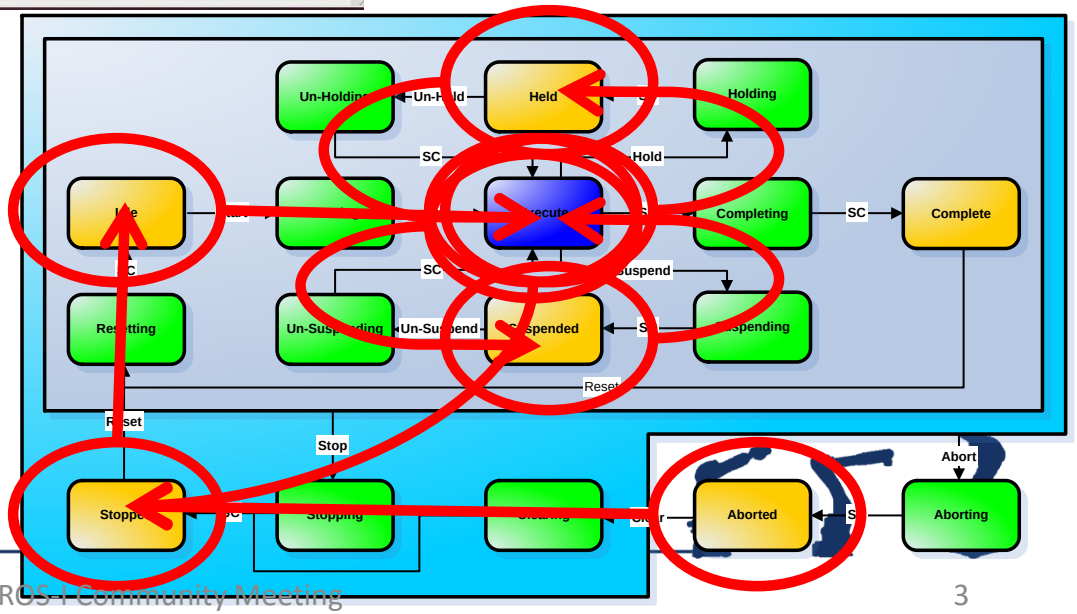
PackML Demonstration



Aim: PackML state transitions initiated from PackML GUI

Benefits:

- State machine applied to ROS C++ node for any industrial application
- State control reporting ROS-I messages, reusable GUI widget

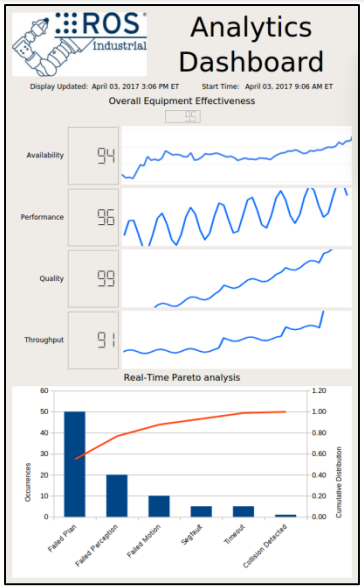


Contributed by:

+1 PlusOne Robotics

Business Analytics Dashboard

- Wikipedia: PackML (Packaging Machine Language) is an industry technical standard for the control of […] industrial automation.
- PackML provides:
  - Standard defined machine states and operational flow
  - Overall Equipment Effectiveness (OEE) data [4]
  - Root Cause Analysis (RCA) data[4]
  - Flexible recipe schemes and common SCADA or MES inputs[4]
- The Business Analytics Dashboard (pictured right) provides the user an intuitive display of **the real-time root** cause analysis and **OEE**



Approach

- Open source tools will be used to create the Dashboard, there is no need to "invent the wheel" on any components, leveraging the benefits of ROS.
- The components for development are available gui (QT), plots (pyqtplot) and communication with the robot (ROS).
- A generic PackML test system is available to developers for testing
- A web-based Ruby on Rails implementation of the dashboard is desireable for operation on ANY system (windows, tablet, etc.)

Metrics for success:

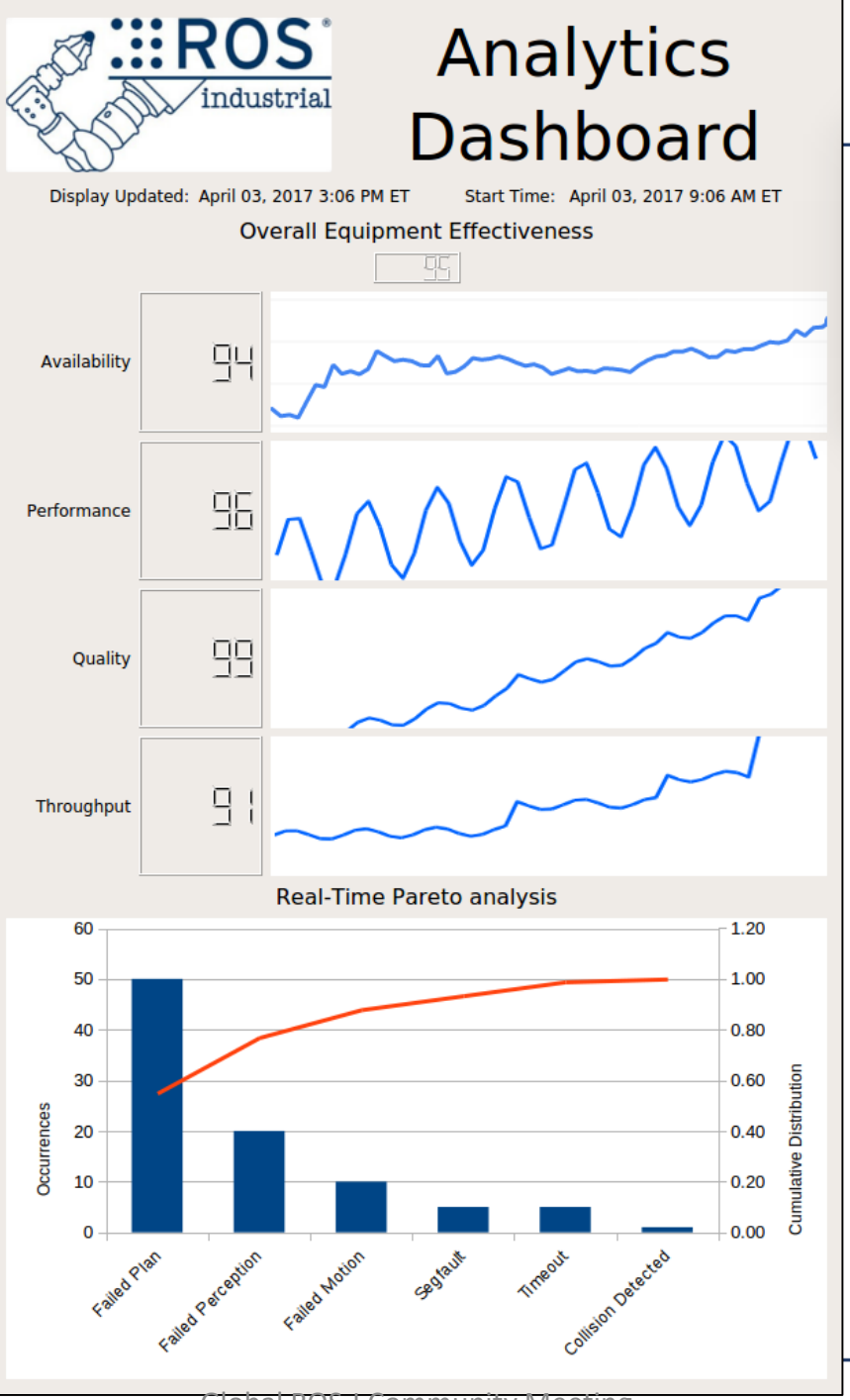
- **GUI demonstration on PackML system**

Motivation/Objective

- **Motivation:**
  - Displaying the real-time OEE allows the end-user to **measure and increase the ROI of the robot asset**.
  - Standardization using the PackML state machine allows for swift implementation and reporting.
- **Objectives:**
  - Real-Time Pareto Analysis
  - Instantaneous & Historical OEE (Overall Equipment Effectiveness)
  - QT & Ruby on Rails implementation
  - Example code and documentation

Scope Of Work

- Developer 1
  - Task: QT implementation of OEE displays
  - Schedule: 1 week
- Developer 2
  - Task: QT implementation of Pareto Analysis
  - Schedule: 1 week
- Developer 3:
  - Task: Documentation, Examples & Testing
  - Schedule: 2 week
- Developer 4:
  - Ruby on Rails implementation of the
  - Schedule: 3 weeks



Data from State Transitions: -

- Execute
- Hold
- Suspend

PackML Call for Contributors

Current Contributors:

- ROS-I AP: Mingli Han, SMACH and remote plc
- PlusOne Robotics: Shaun Edwards, C++ Package
- 3M: Schoen Schuknecht, Lex Tinkett, Tom Strey: PLC and PackML support
- SwRI: Austin Deric, Paul Evans

- Call for contributors and testers: C++ Package, SMACH
- Call for contributors for next phase (3-4 months)
  - Business Analytics Dashboard

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