

Collaborative robot P-Rob®

A great platform for research and education

The personal robot P-Rob 2 of F&P Robotics is an ideal platform for researchers in the areas of robot control, human-robot interaction and artificial intelligence. It covers the vast majority of needs for producing advanced developments in these fields.



1. Overview

Hardware

- 6 DOF robot arm, intrinsically safe (24V version; 2x speed 48V version available)
- Embedded PC running on Linux (Ubuntu)
- Angular two-finger gripper with integrated sensors (exchangeable): Active infrared sensors on the fingertips, a distance sensor between the fingers and position and force sensing embedded in the gripper
- Adapter for third-party grippers
- Optional Camera module on gripper and third-party vision system support
- Optional additional high-resolution 6 DOF force-torque sensor, positioned between arm and gripper
- Options for linear axes and mobile platform hardware, already connected to software environment and SLAM architecture

Software:

- High performance ROS support including the ROS motion library MoveIt
- Python Scripting Language with full control just through a web browser interface (no additional installations needed)
- myP software for control of P-Rob and extensions based on web browser based GUI
- Real-time motion control module allowing users to directly connect to any robot control software
- Position, velocity and torque (based on motor current) control for each joint
- Integrated features to
 - o support for IP-Sockets to integrate separate layouts, sensors, cameras etc.
 - o apply neural networks for object recognition
 - o include a situation planner based on probabilistic reasoning
 - o support face, gesture and language recognition
 - o build custom skills as combination of functional scripts and hardware
 - o connect to other hardware such as linear axes and mobile platforms
- 3D grid teach-in wizard
- Simulation with Gazebo (ROS) and separate myP functions (showing robot and all taught points in space).
- Modbus TCP Ethernet interface to connect to any PLC (Siemens, Mitsubishi, Beckhoff, Wago etc).
- Digital I/Os and CanOpen connection socket embedded in the robot.

Let's highlight some of these aspects in the following.

2. Motion Control Module (MCM)

The Motion Control Module provides a very fast (control loop up to 100 Hz) control interface of P-Rob2. It aims to provide an easy integration into different existing software frameworks using JSON over TCP/IP as a means of communication. It is intended to be used for Machine-to-Machine (M2M) communication and provides also an optional text-based Human-to-Machine interface (HMI).

Features

- Calibration (using mechanical stops or light barriers)
- Position control loop up to 100Hz providing smooth movements
- Release mode allowing positioning of the robot by hand with friction and gravity compensation
- Sophisticated safety checks in all modes
- Well tested (coverage estimated at 95% of the code base)
- TCP JSON-based M2M interface

Options

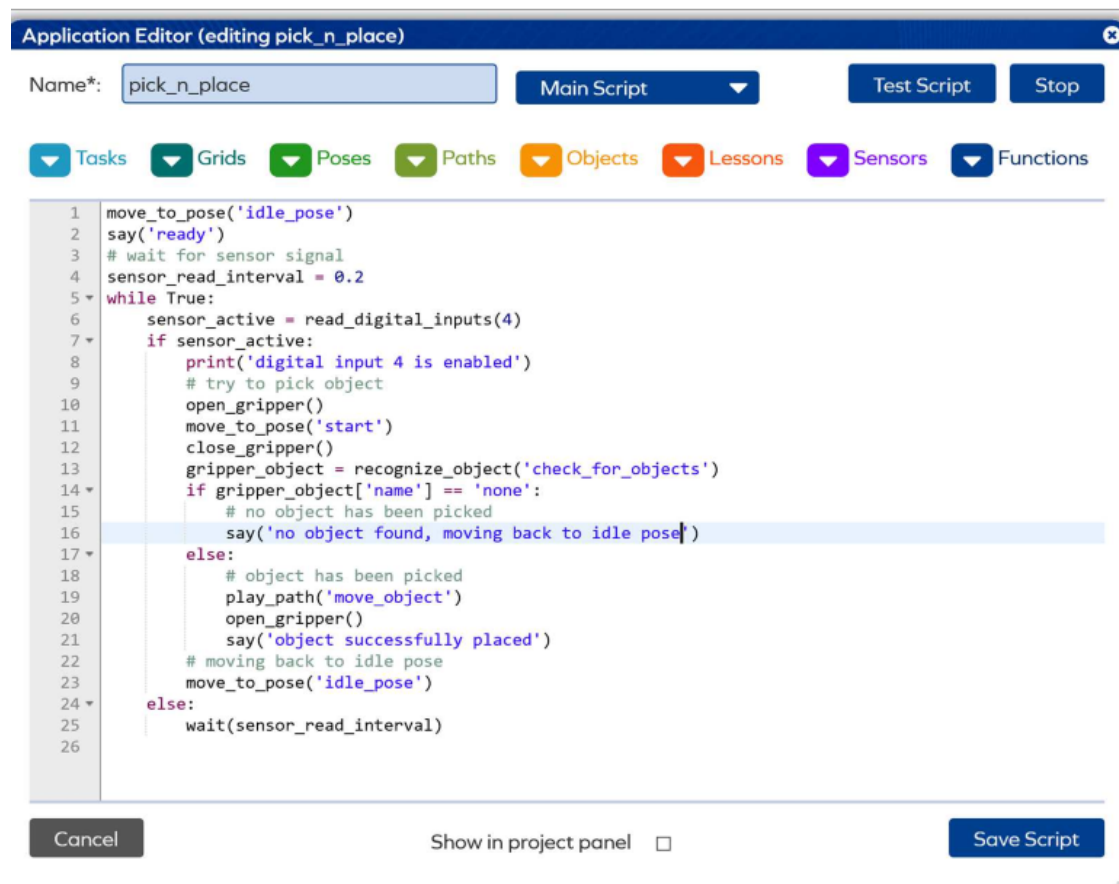
- TCP text-based HMI interface
- C++ API, Python API
- ZMQ interface

Operating modes

- HOLD: Axes are kept at their current positions
- RELEASE: Axes can be moved by hand
- Smooth position control through PVT (Position-Velocity-Time mode)
- TORQUE_CONTROL: Torques provided by external controller
- VELOCITY_CONTROL: For reactive trajectory modification and online motion planning
- OFF/ERROR: Axes are kept at their current positions. Axes powered OFF or in error state

3. myP Software

myP is a Powerful software package for robot control, teach-in, scripting, automatic task generation, learning modules based on neural networks and probabilistic estimation. Interaction ranges from easy teach-in functions with hand guidance of the robot to sophisticated programming using python libraries and dozens of myP functions for P-Rob. The dynamic robot model allows for gravity compensation, movement optimization and interaction with environment, humans and other robots.



Script Editor of myP, available directly inside the browser application

4. ROS Integration

P-Rob supports a direct ROS connection to the backend allowing users to send commands and receive information with high performance. This ROS package “myp_ros” contains everything you need to integrate P-Rob into your ROS environment. Check it out at:

https://github.com/fp-robotics/myp_ros

Additionally, a gazebo model of P-Rob is available, allowing standalone and synchronized simulation of the collaborative robot. The following packages are provided:

fp_gazebo

This contains the gazebo model, a joint angle plugin which connects with ROS, and a world file which loads the model and plugin. Installation and startup scripts are provided to make integrating your P-Rob with Gazebo simple and easy.

fp_descriptions

This contains the URDF models for use in RViz.

5. Product Overview



Additionally, many extensions are available including:

- Linear axes
- Mobile platforms
- Support of collaborative third-party grippers such as SCHUNK Co-act-EGP



P-Rob with ISO normed gripper connector and SCHUNK collaborative parallel gripper



Personal Service Assistant Lio, including P-Rob and a sophisticated sensor equipped mobile platform

6. Benefits Summary

- ✓ P-Rob is well suited for collaborative robotics as well as service robotics. During the design and development of P-Rob, great attention was paid to situational awareness and adaptive behavior as well as the concept of intrinsic safety. The myP software offers a very easy way of teaching and communicating with the robot including vocal and body language. The soft shell of P-Rob with a synthetic leather skin lowers haptic barriers and offers unique opportunities for sensor deployment.
- ✓ P-Rob is more than just a robot arm. The all-in-one concept (robot arm with embedded PC plus gripper plus software) allows fast and simple automation of both stationary and mobile work stages. Compared to ordinary industrial collaborative robot arms, no external devices, like controller boxes or third-party PCs, are needed.
- ✓ P-Rob focuses not only on its tasks but also on its working environment. Using algorithms of artificial intelligence, optional sensors and vision systems, the environment can be perceived and specific actions can be carried out depending on the actual situation. Furthermore, P-Rob can control all kinds of devices via numerous interfaces, allowing mobile platforms, machines, linear axes and many more to be easily integrated into automation solutions.
- ✓ The combination of embedded PC with local computer devices and online cloud functions allow infinite possibilities for research and advanced mobile service applications.

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