

# RoboCup Rescue 2018 Team Description Paper

## Quix

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### Info

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**Abstract**—“Quix” is a team of Tadokoro Laboratory from Tohoku University, Japan. we use a tracked vehicle “Quince” as a mobile base and is developping a new manipulator, control system and user interfaces to meet the specification of robocup rescue.

**Index Terms**—Tracked vehicle, Manipulator, SLAM, recognition.

### I. INTRODUCTION

“Quix” is a team of Tadokoro Laboratory from Tohoku University, Japan. we use a tracked vehicle “Quince” as a mobile base and developping a new manipulator, control system and user interfaces to meet the specification of robocup rescue.

Our goal of the in the RoboCupRescue 2018 is to evaluate the manuevaring ability of our robot system. Our main development target is 6 DOF manipulator which can complete the manuevaring tasks in the RoboCupRescue.

### II. SYSTEM DESCRIPTION

As a mobile base, we use tracked vehicle named “Quince”, shown in Fig.1. Now we are developping manipulator, control system, SLAM system, recognition software and user interfaces. Main development targets are described on Fig.2. Details are desclibed below.

#### A. Hardware

We use “Quice”, shown in Fig.1, as a mobile base. the robot has tracked body and 4 active flippers so that the robot can traverse on very rough terrein including stares, random steps or a high single step up to 40 cm. The robot weight is 33kg and payload is about 10kg. Thus, additional devices such as sensors, manipulators or extra batteries can be equipped on the robot. Litium-ion batteris are attached inside the tracks and it runs at least 90 minutes though the robot continuously traverses on the rough terrein. The robot has cameras on the front and back, so the human operator can control the robot using those camera information. Detaild information of the robot is shown on Tab.I.



Fig. 1. Tracked vehicle “Quince”. We use this robot as a mobile base.

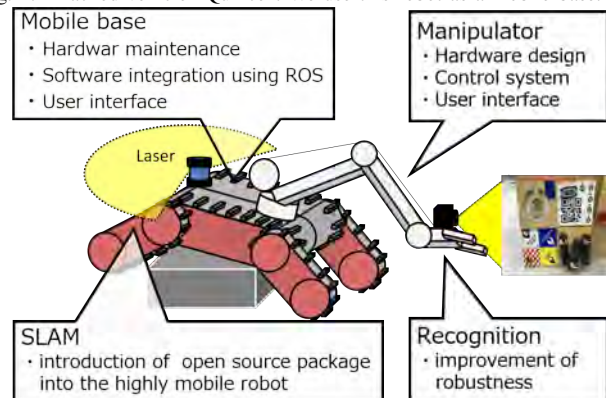


Fig. 2. Development targets of the project.

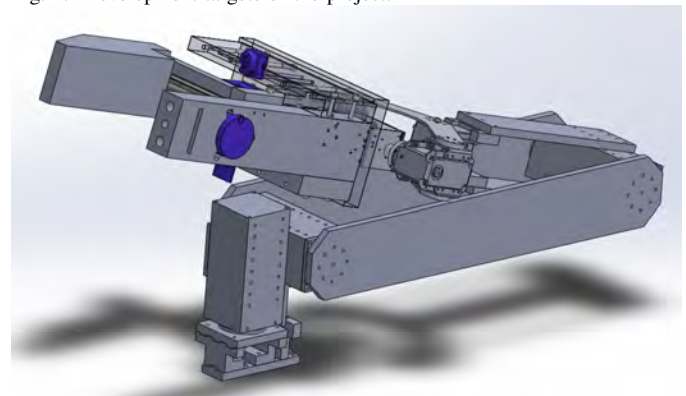


Fig. 3. CAD design of 7 DOF manipulator equipped on the robot.

Now we are developping new manipulator system. CAD design is shown on Fig.3. The Characteristic of this manipulator is that pallel link is used as a first link to increase the static payload. The manipulator has 6 DOF and can extend itself at

most 1.2m above the ground. It consists of 3 Dynamixel Pro motors[1] and 3 Dynamixel motors[2]. The payload is 2kg so that it can deal with square bars in the maneuvering tasks.

For the 2D SLAM, We attach 2D laserscan sensor. The sensor is attached on the pan-tilt mechanism with two servo motors to stabilize the sensor on rough ground.

## B. Software

1) *Mobile base*: The robot has two motors for driving tracks and four motors for active flippers. Those motors are controlled using EPOS4 motor driver. we use "epos hardware" package [3] to control the motors and get the state of it. Human operator controls the robot using joystick in the operator room and velocity command is sent to the robot via wireless communication.

Human operator can control the robot based on the camera information. Also, we have developed a graphic user interface of the tracked vehicle, shown in Fig.4. Using the interface, the operator can easily know the state of robot including angles of active flippers, pose of the robot on 2D map, robot trajectory and laser scan sensor datas. After the integration with manipulator, we extend this GUI to visualize the pose of manipulator using the same screen.

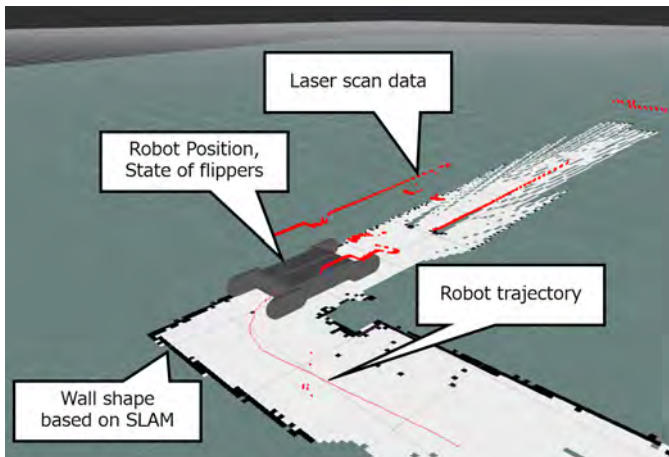


Fig. 4. Graphic user interface of the robot. It visualizes the angle of active flippers, robot pose on 2D map, trajectory and sensor data. Human operator can easily know the state of the robot from a single screen.

2) *Manipulator*: In maneuvering tasks, human operator would like to command the linear and angular motion separately to the end-effector while the tasks, such as pulling doorknob, pulling rod out from a pipe, and building scaffold using wood bars.

To meet the requirement, we will use "Moveit" package[4] as a manipulator controller. It provides inverse kinematics solver and path planner. By using the package, operation gets much easier because operator should just command the goal position of the end-effector while maneuvering tasks. Also, It provides useful control interface, shown in Fig.5.

Currently, we have finished a mechanical design of manipulator. After this, we will implement the software part described above.

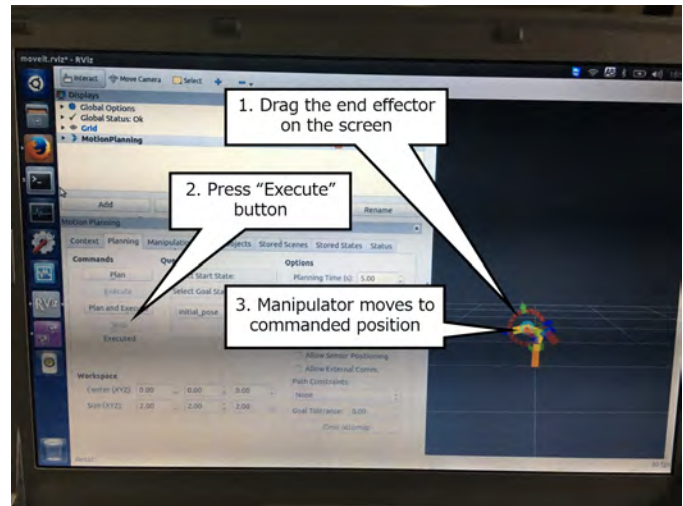


Fig. 5. Graphic user interface of "Moveit", manipulator controller. Operator can easily command the end-effector position by dragging the end-effector on the screen.

## C. Communication

5GHz Wi-fi is used for the communication between robot and operator's laptop. communication channel can be changed by resetting wireless router between the games.

## D. Human-Robot Interface

We have developed a GUI of tracked vehicle shown in Fig.4. The operator can know the state of robot using camera views and the GUI information. Operator commands the motion of the mobile base using joystick. Manipulator is controlled using GUI based interface, shown in Fig.5, by dragging the end-effector on the screen using a mouse. To increase the speed of manipulation task, we may compare the GUI-based control interface and Joystick-based one and choose the better way.

## III. CONCLUSION

In this paper, we described our development target, direction, and progress. In May 2018, we will completely integrate the system and test it in Robocup Japan Open.

## APPENDIX A

### TEAM MEMBERS AND THEIR CONTRIBUTIONS

- Yoshito Okada                      Team leader, project management
- Shotaro Kojima                    Hardware setup of mobile base, integration
- Eri Takane                            Mechanical design of manipulator
- Naoki Mizuno                        Software development of manipulator
- Tori Shimizu                         Operator, Mechanical design of end-effector

TABLE I  
SPECIFICATION OF THE ROBOT

Attribute	Value
Name	Quince
Locomotion	tracked
System Weight	33kg
Weight including manipulator	40kg
Transportation size	0.5 x 0.7 x 0.5 m
Typical operation size	0.5 x 1.0 x 0.5 m
Battery endurance (idle/ normal/ heavy load)	240 / 120 / 90 min
Maximum speed (flat/ outdoor/ rubble pile)	0.5 / 0.3 / 0.15 m/s
Payload (typical, maximum)	5/ 10 kg
Arm: maximum operation height	120 cm
Arm: payload at full extend	0.5kg

## APPENDIX B

### LISTS

#### A. *Systems List*

#### ACKNOWLEDGMENT

The authors would like to thank to the professors of our belonging laboratoris, who understands our motivations and supports this project.

#### REFERENCES

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