MICR Rescue Robot
Manipulator module
Technical Report
I. INTRODUCTION

Rescue robot project was initiated by the Ministry of the Interior of Czech Republic. The ministry provides funding for the project. Project is supervised by doc. Ing. Dipl.-Ing. Martin Drahanský Ph.D. The goal of the project is to develop a robot that can be used by rescue forces for searching for victims of natural disasters in hazardous situations like snow avalanche or collapsed building.

II. BRIEF DESCRIPTION OF ROBOT

The robot compounds of base with tracks that can operate in hard terrain and several modules that are installed for particular tasks. Robot modules include sensor module for robot navigation with lidar and stereo camera, sensor module with bioradar for searching for people under collapsed buildings or behind walls, avalanche sensor module and a manipulator module.

Figure 1: Draft of assembled rescue robot with manipulator module.
Manipulator module adds universal manipulator to the robot with 3 degrees of freedom and with two-finger gripper. The manipulator can carry 5kg of payload. Kinematic schema of the manipulator is visualised in figure 2. Manipulator is equipped with additional sensors: camera between fingers and thermal camera on second link of the manipulator. Manipulator has to be able to manipulate with objects in observable but unknown environment. In this task manipulator control cooperates with human operator. The operator
recognizes movable and graspable objects and informs robot about them. Then the robot reaches the object with the manipulator or reports that the object is unreachable.

Control of the manipulator is based on MoveIt! stack of Robotic Operating System (ROS) [1]. For simulation purposes the OpenRAVE toolkit was used [2]. High level control is responsible for planning of motion of the manipulator. Motion plan includes avoidance of collision with robot body.

Manipulator motor wiring and low level control was solved by Ing. Jan Váňa, high-level manipulator control including trajectory following and inverse and forward kinematics was developed by Ing. Radim Luža.

**CONCLUSION**

Manipulator module was completed and tested under laboratory conditions. Testing includes motor motion, inverse and forward kinematics precision and motion planning.

**BIBLIOGRAPHY**
