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Abstract:

Since its establishment in 1989, the dept. has been focusing on the complex field of robotics - in education, research and science and expert services for practice. According to the current trends, the department members concentrate mainly on the service robotics and robototechnics and on application of robots in non-machinery branches.

Currently, the dep deals with problems related to detection and emergency robots for rescuers, firefighters, and pyrotechnics. The department has its technical background in the Robotics Centre laboratories and also in the Centre of Advanced Innovation.

Detailed research information:

The Department of Robotics has already developed few mobile robots of different conceptions and purposes. The most recent mobile robot and currently also the most complex one is the mobile robot called Hercules. This robot is primarily assigned for initial reconnaissance of areas of emergency and was constructed with the aid of the TANDEM project of the Ministry of Industry and Trade of the Czech Republic, with some companies from the region participating on it.

Construction

The undercarriage of the mobile robot is based on an electric wheel-char, which was mechanically modified on the department to allow placement of all the additional electronic and fixation of the manipulator. Thanks to the utilisation of a highly optimised and constructional very well designed undercarriage the robot has some great parameters, for example the reach, loading capacity, range of speed, power and manoeuvrability.

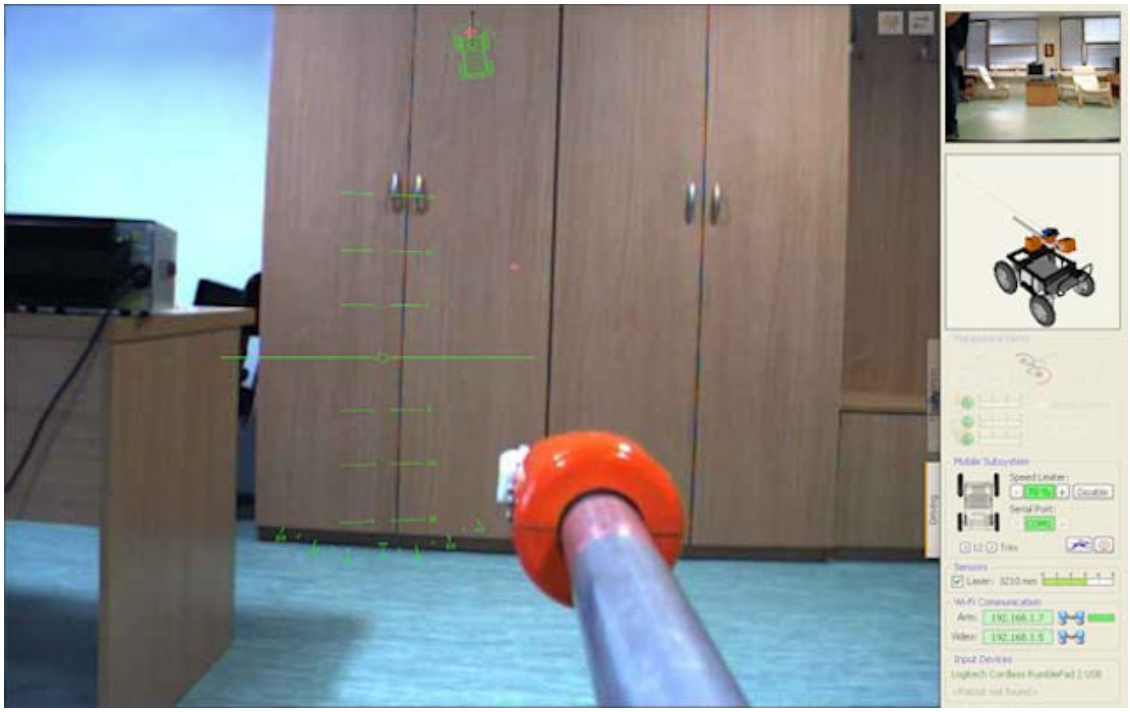
The manipulator was completely designed and built by the department. The main requirements were low costs and simplicity of the construction. Because of the simple construction, the manipulator has almost zero mechanical looseness and thus it is possible to perform very small and precise movements. The arm has 3 degrees of freedom; all the joins are driven by electromotor with harmonic gearing components. The arm is currently equipped with a two-jaw gripped with controllable gripping force, but any other effector can be used instead in the future.

Control system

Quite a demanding task was to adopt the original control system of the wheel chair for remote control from a computer, because of the use of a specific closed CAN-based communication. In the end, the mobile robot movement (driving and steering) can be controlled remotely by a human operator using a gamepad and it is possible to implement autonomous operation. The human operator controls the robot from a case containing the required electronic components for wireless communication and a notebook with touch-screen. All the functions of the robot are integrated into a single, user-friendly graphical application, which lays emphasis on the picture from the camera subsystem. Additional useful text and visual information's are added to the camera pictures or displayed on a control panel.

The manipulator can be operated in three different modes:

- forward kinematics – useful to look around with the cameras mounted on the last arm link,
- inverse kinematics – useful for manipulation tasks, in cylindrical or Cartesian coordinate system,
- operator's hand movement tracing – useful for very complicated manipulation movements, the effector follows movements of the operator's hand holding a special sensor.



Stereovision and sensory subsystem

The last link of the manipulator arm is equipped with a camera head incorporating two stereovision cameras and a proximity laser sensor.

Stereovision system offers a 3D view of the scene around the robot, which highly increases the depth perception and allows both the easier manipulation and navigation. The operator must wear stereovision glasses to see the 3D effect.

The stereovision cameras are fixed in mutually parallel directions and focusing on the point of interest in the space is purely software-based. Besides this, the image-processing software, created on the department, can also measure distances to detected objects in the field of view and this information can be integrated into the camera image in the form of colour gradient.

Another way to measure distances to obstacles are proximity sensors. Currently, the robot has only one proximity sensor, situated on the camera head. The team is already working on adding more sensors, which would allow also unmanned operation of the robot – laser scanners, IR or laser distance sensors, GPS and compass.