The Mobile Robot ARTOS

Small Service Robots for Assisted Living Environments

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Abstract

The current situation in demographic development leads to numerous approaches aiming at the integration of technology into elderly life. To cover aspects of audio-visual supervision and behavioural data a lot of sensor systems are necessary.

However the acceptance for such systems is expected to be low and difficult to gain if complete living areas have to be induced with cameras, microphones and building automation. We argue that a mobile service robot with integrated multi-medial hardware can improve the acceptance of technology-related emergency recognition and supervision. Furthermore, the quality and flexibility of the application itself may benefit. The proposed solution is of course a best-effort system which under certain circumstances can encounter problems.

1. Assisted Living Applications

Astonishingly in the robotics domain only autonomous vacuum cleaners made it so far to the domestic consumer market, although the various fields of robotic engineering have been addressed for decades. We think that this is because the focus of research often is not directed towards pragmatically useful appliances and robust and simple system design. To start in this direction within the motivated domain, three fields of application have been identified: Transportation tasks, emergency situations and communication. To enable our robot to serve as a transportation aid made it only necessary to provide a mountable table unit for it. Of course during product development it would be necessary to design a solution that deals with the units' stability and the convenient size of transport area and payload. The

second application area is the most interesting at the current state of the project: Using the mobile system in case of emergency assumption as a tele-operable agent that transmits audio-visual information has been identified as a very valuable add-on. Of course one has to think of the robot as an already present service robot. For example vacuuming is already a big market in robotics.

Working together with the central bureau for emergency calls in our city we are did first evaluations regarding usability and impact of our solution.

Our robot runs a light-weight web-server providing convenient access to both, drive control and camera control (pan-tilt and zoom).

A third envisioned application scenario is to use the system as mobile communication agent for both, an intelligent living environment and a proactive video-telephony. System warnings, reminder messages and proactive user stimulation are also a benefit in assisted living environments. A stepwise behaviour of the system could look like as follows: In order to keep the elderly inhabitant mentally active, the system may perform regular stimulation by speech output. In cases where the overall environment with its door and movement sensors comes to a state where too low human activity is detected, the system can work as a proactive mobile video-phone and call relatives by own initiative.

At a third state in a case where the system comes to the conclusion that with a certain probability a harmful situation might have developed, the system can call emergency personnel and turn over control of the mobile robot.

2. Recent Developments in Robotics and Assisted Living

The robotics community has been quite active providing ideas and solutions for elderly care and physically impaired people. Walking aids [1], guidance systems for the blind [2] and complex service systems like the Care-o-bot project [3] are only some examples.

Further information to the intelligent environment for assisted living that we are using for our implementations may be found under [4], [5].

3. State of Implementation

The mobile platform used in our solution is the mobile robot ARTOS (Autonomous Robot for Transport and Service) which is particularly designed to operate in living environments.

To deal with the problem of fuzzy and unstructured obstacles, a powerful layered obstacle avoidance system is in place [6].

This is necessary as a tele-operated system, especially when routed over the internet, encounters latency issues.

Intuitive and safe tele-operation therefore is only possible if the system provides sufficient collision avoidance functionality which is of course also mandatory for autonomous drive.

4. Conclusion

The combination of our mapping and navigation components with the web-based tele-operation makes it easy to manoeuvre the robot semi-autonomously even with bad network connection. Giving destination coordinates or semantic room destinations or even setting the robot into an exploration mode reduces the amount of training necessary for the tele-operator.

Our experiences so far with the project partners with medical background showed that the quality of the provided video-data serves very well to get an impression of the situation of a human inhabitant. Thoughts about acceptance have led to the conclusion that the system has to come on a platform for daily use, e.g. a vacuum cleaner robot.

Size length:	55cm, width: 33cm, height: 26cm
Weight:	25kg
Payload:	50kg
Kinematics:	Differential drive
Wheels:	2 active on centred axis, 2 passive at front and rear
Motors:	2 Faulhaber 2657WO24CR
Dynamics:	max. speed: 50 cm/s, max acc.: 25 cm/s²
Power:	24V lead battery with 10Ah
Operation Time:	approx. 3h
Computer:	Intel Core2 Solo ULV, CAN Interface
Motor Control:	Motorola DSP 56F803
Operating System:	Gentoo Linux, Kernel 2.6.21.5
Multimedia:	Speakers, microphone, touch screen, Text To Speech
Camera:	360°/180° Axis PTZ
Collision Sensors:	Laser, Ultrasonic, Tactile

Table 1: Technical specifics of ARTOS

Figure 1: WEB-GUI for Tele-operation

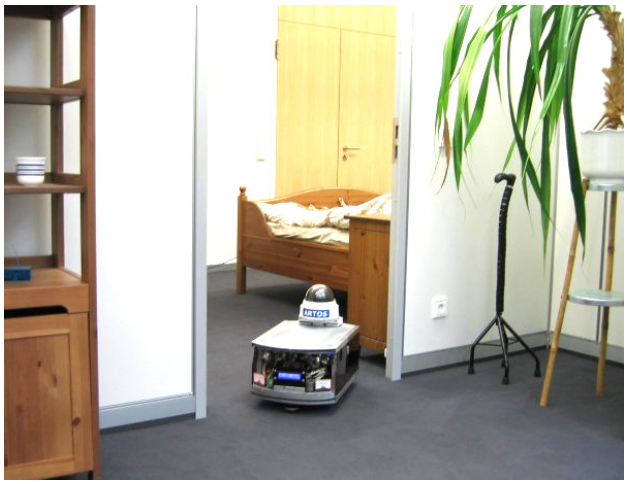

Figure 2: ARTOS used for situation analysis

4. References

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