RoboCupRescue

Robot League Competition

Padua, Italy

July 4-11, 2003

PARTICIPANT INFORMATION SHEET

TEAM NAME: IUB 2003 Rescue Team	ORGANIZATION: International University Bremen (IUB)
CONTACT NAME: Andreas Birk	COUNTRY: Germany
TOTAL NUMBER OF TEAM PERSONNEL: 6	EMAIL: a.birk@iu-bremen.de
ROBOT NAMES: mother-goose, papa-goose, duckling 1 - 10	TELEPHONE: +49-421-200-3113
WIRELESS FREQUENCIES (PER ROBOT): 2.4 & 5 GHz; 413, 433, 868, 918 MHz	FAX NUMBER: +49-421-200-3103

x PRE-REGISTERED ☐ REGISTERED ☐ ARRIVED ON SITE ☐ COMPETITION READY

PLEASE DISCUSS YOUR APPROACH TOWARD KEY DESIGN CHARACTERISTICS (WITH EMBEDDED PICTURES):

Locomotion: [wheeled, tracked, legged, specify other]

- mother-goose
  - 6-wheel differential drive
  - 200 W mechanical power
- papa-goose
  - tracked drive
  - suited for stair-climbing
  - 200 W mechanical power
- duckling 1 to 10
  - small tracked drive
  - for autonomous exploration

Mother- and papa-goose are two medium-sized, semi-autonomous devices.. The ducklings are small, fully autonomous robots that can be carried and deployed by the two geese.

Sensors for navigation: [tactile, acoustic, sonar, infrared, visual, specify other]

- mother- & papa-goose
  - odometry
  - compass

    - active infra-red
    - ultra-sound
    - bumpers
- ducklings
    - compass
    - active infra-red
    - communication for collective map-building

Mother- and papa-goose rely on odometry fused with compass-data for dead-reckoning. The obstacle sensors are used together with the dead-reckoning to build a probabilistic map of the environment.

The ducklings use only heading information from a compass and local exchange of information when two (or more) ducklings meet. This is used for collective localization and map-building.

Sensors for victim identification: [tactile, acoustic, sonar, infrared, visual, specify other]

Mother- and papa-goose use passive infra-red (body heat) sensors for autonomous identification of victims. Video and audio streams are used for victim identification by the operator. Work on autonomous identification of victims from video data via machine vision is on the way.

The ducklings identify victims solely via passive infra-red (body heat) sensors. They activate in this case a video transmission to the operators console to rule out false positives.

Sensors for localization: [tactile, sonar, infrared, visual, encoder, ladar, specify other]

Mother- and papa-goose rely on odometry fused with compass-data for dead-reckoning. In addition, the map that is build based on data from the obstacle sensors is fused with the dead-reckoning for probabilistic localization.

The ducklings start with a random-walk search pattern that gets more structured over time as they collectively build a map. Localization information is based on heading via a compass and mutual identification when they encounter each other during the exploration of the area.

Control scheme: [teleoperation, partial autonomy, full autonomy]

A single operator controls the 12 robots.

The two geese are semi-autonomous, i.e., the operator specifies small, short-term tasks like move to a target location, which are autonomously carry out. The operator is in addition assisted by autonomous functionality like map-building, identification of victims via passive infra-red and in the future via machine vision.

The ducklings are fully autonomous. Once they are deployed, they explore the environment to search for victims and for map building. In case a passive IR-sensor of a duckling reports a potential body, the robot emits an acoustic signal and opens a video-transmission to the operator to rule out false positives. In addition to the localization of victims, the ducklings contribute to the construction of the map.

Communications: [each particular frequency, spread spectrum range]

The geese can use 802.11 RF-Ethernet on the two available frequencies (2.4, 5.0 GHz) and bandwidths (theoretical maximum 11, 54 Mbit/s).

The ducklings use proprietary RF-modules at 413, 433, 868 or 918 MHz for short-range, low-bandwidth communication (maximum 40 Kbit/s) and IR-communication for mutual identification. In addition, they share 4 analog video channels at 2.4 GHz that are only used for short periods in case of potential victim identification. Last but not least, the ducklings use sound to indicate the potential victim identification to the geese and rescue workers.

Map generation/printing: [operator/drawn, computed/drawn, computed/printed]

The map is computer drawn and printed. The map is based on a probabilistic occupancy grid, i.e., it shows the free space and obstacles as gray values. A hall-way for example is shown as white floor and black walls.

Standard localization and mapping techniques are used on the geese. In addition, data from a novel collective approach for map building is used with the ducklings. This approach relies on heading information and simple information exchange when ducklings meet.

The identified victims are indicated in the global map that is printed at the operator's console. In addition, a duckling that is located at an identified victim can provide a sound beacon that directs rescue workers to–this location.