INTROBOT®

THE ROBOT MAIN FEATURES

Developed by
INTROSYS
Global Control System Designers

POR LISBOA
PROGRAMA OPERACIONAL REGIONAL

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LabMAg
laboratório de modelação de agentes

1. REAL TIME THROUGH CAMERAS ON BOARD THE ROBOT

One of the main features of the Introbot is its capability of operating in remote locations, which may or may not be accessible to human beings. As such, the Introbot offers the possibility to capture and transmit in real-time images of the surrounding environment so that the operator at the control centre can “look through the eyes of the robot” allowing safe navigation and an efficient operation. To this end, the Introbot includes a closed video system over IP, comprising of a set of wide angle cameras arranged so as to capture panoramic images of the surrounding area.

In order to enable its use in surveillance and monitoring of perimeters, the Introbot also includes a robust pan/tilt high-speed camera with optical zoom up to 18x. This camera also includes an infra-red light projector to capture images in high quality and in different light conditions, whether during the day or at night

Track images captured by the INTROBOT and sent to the Control Centre

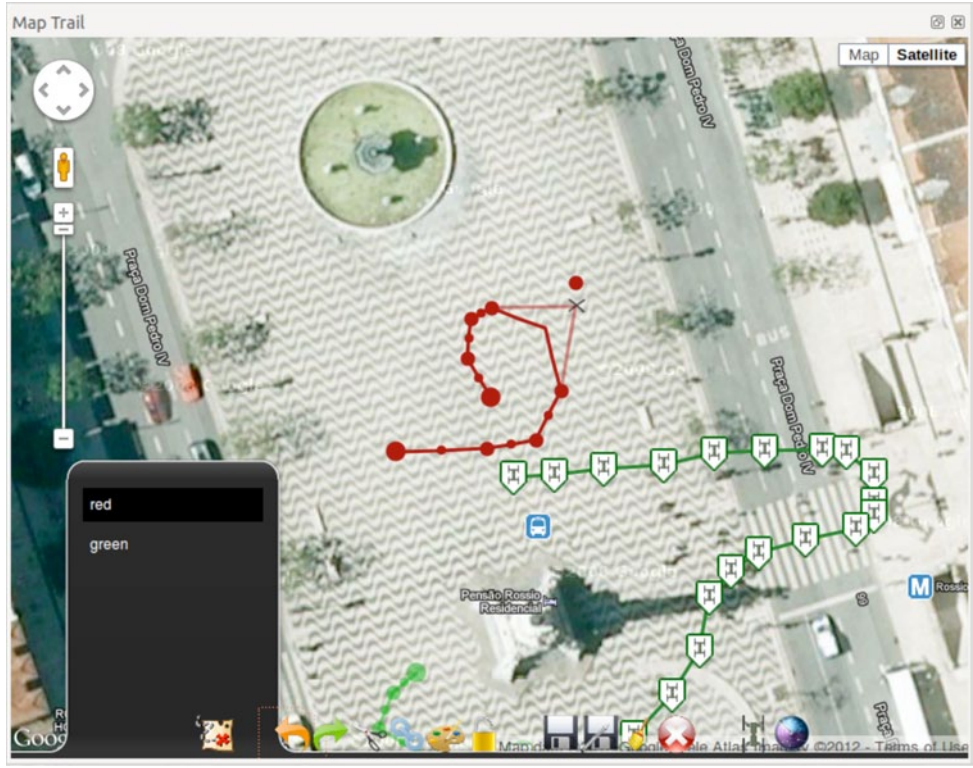
2. PLANNING AND EXECUTION OF ROUTES WITH GOOGLE MAPS SUPPORT

The planning of routes is facilitated by the integration of Google Maps service in real-time and instantaneous in the operator interface. Several routes can coexist simultaneously, and the selection of each route is mutually exclusive (i.e. only one is selected at any given time for that operation, the others remaining idle). The routes can be fully edited: modify, remove, add. The path can be changed by simply dragging one of the key points that divide sections. Dragging, using the intermediate points (between two key points), changes the route and divides the respective section, adding a new segment. The key points are interpreted at the moment of creation, by touching the screen, and the respective geographical positioning coordinates are automatically assigned in relation to the visible map. A route may be divided into two, and two routes may be joined into one. The operator has available to him/her the possibility of choosing or changing the colour (from a palette of millions of shades) of the points and segments of a given route. The routes are stored in the repository where the application runs, persisting between work sessions. The operator can at any time choose one of the routes and send it to be followed by Introbot.

Additionally, following of the robot is made with high precision and its route is marked on the screen with

2. PLANNING AND EXECUTION OF ROUTES WITH GOOGLE MAPS SUPPORT

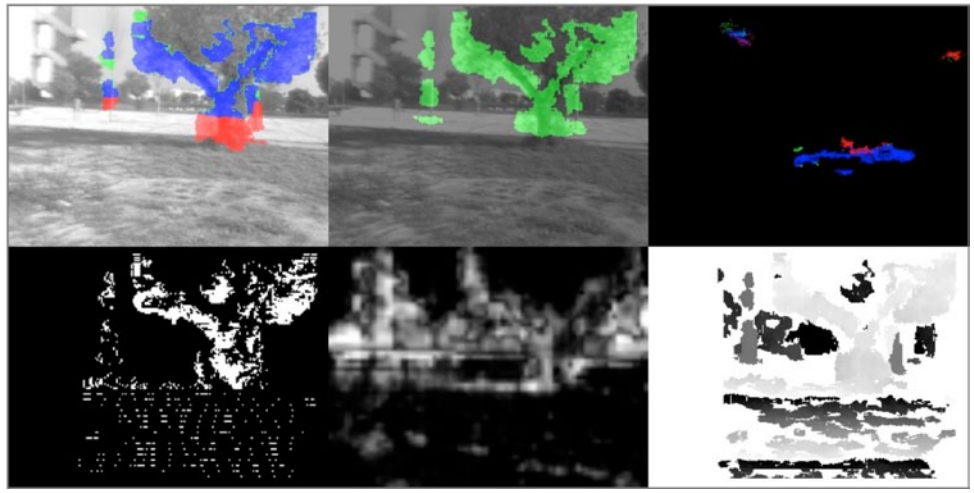
visual artefacts for the different key points. These artefacts highlight the geographical positioning coordinates sent by the robot. The operator may choose to show or hide the current route of the robot.



3. SAFE AUTONOMOUS NAVIGATION THROUGH THE DETECTION OF OBSTACLES

Be it in teleoperated mode or autonomous navigation, the Introbot has the ability to identify, map and avoid obstacles in its way. To this end, the Introbot carries with it a set of perceptual sensors composed of a two-dimensional laser scanner for biodimensional measuring of distances, a binocular camera that, like the human eye, allows for the estimation of the relative position of objects present in its visual field, and a set of sonar sensors to detect the approach of the robot to obstacles. This set of sensors, being complementary to each other, allows the supply to the software package responsible for processing captured sensory information. The latter, in turn, will execute the discretisation of the obstacles based on their form and appearance, discarding those that do not offer resistance to the passage of the robot.

In case of positive detection of obstacles in the path of the robot, this software prevents the robot from moving in the direction of the obstacle and suggests, where possible, a safer route.



Images of obstacles in the control centre

4. AUTONOMOUS FOLLOWING OF ROUTES

Similar to the obstacle detection system, the Introbot is equipped with a system to support safe navigation in the presence of paths. This system allows the detection of a path that is present in the visual field of the cameras arranged on the Introbot and, in partnership with the remote operator or in autonomous mode, guides the robot along this same path. The presence of unexpected obstacles in the path is immediately recorded by the control system, i.e. the robot alerts the operator of the obstacle and if necessary surrounds it. The tracking system of paths is prepared to operate in natural environments, in which biking and pedestrian paths prevail, as well as man-made environments where well-defined structures prevail, such as pavements. The images illustrate two typical situations where the system can operate, as well as the environmental areas (highlighted in red) and which the system regards as belonging to the path to be followed and therefore, used to guide the movement of the Introbot.

Route Detection

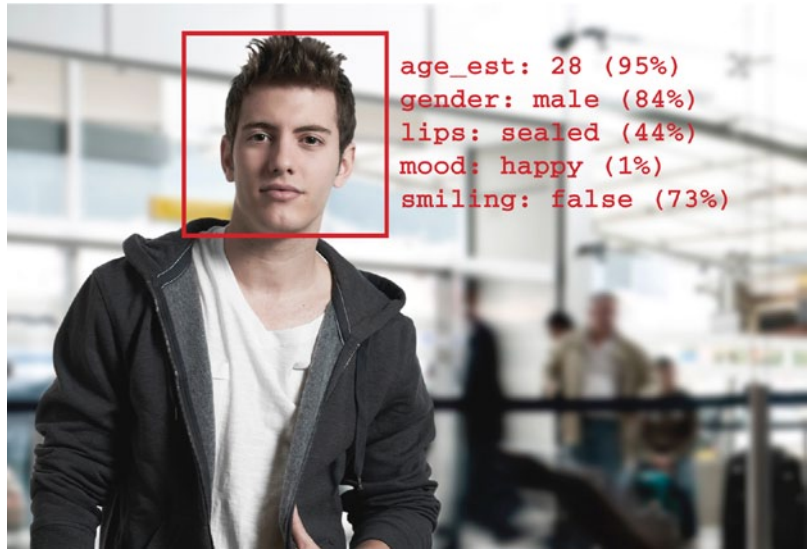
5. FACE RECOGNITION

Face detection works for different dimensions of frontal presentation (in this first version) of the human face. The application is capable of detecting multiple faces positioned facing forward and simultaneously, although with different dimensions. The interval between the lowest and highest detectable face can be set by the operator in the parameters of the application. The (changeable) synthetic colour artefacts in the shape of a square are positioned around the detected face so as to highlight it. In addition to this functionality, the artefact of the robot's orientation, indicating the direction to take next, is visible in the lower right corner of the main view of the monitoring camera. This feature allows through each change of direction between two key points, to highlight to the operator the next turning that the robot will make.

Face Detection

5. FACE RECOGNITION

The recognition of facial features works using a service (face.com) on the Web. It is experimental (in the current version) but functional with limited precision to the current algorithms and processing capacity contracted. In the current version the free option is used, through a web service, with a limit of intensity and number of accesses. The chosen features are: estimated age, gender, lips, mood, smile. With the mood being the most useful for the surveillance operation. The estimate on the various features is always accompanied by the percentage of confidence in the result.



% Confidence in the result

6. INTUITIVE DIAGNOSIS SYSTEM AND FAILURE RECOVERY

Like any complex system, the operational status of the Introbot requires constant monitoring in order to avoid possible failures. This includes monitoring the battery level, overheating of components or the quality of communications. To ease the strain on the human operator and focus their attention on the task at hand, Introbot includes an automatic diagnosis and error recovery system. This system responds whenever it detects system failure and attempts to resolve the failure, by itself. For example, briefly shutting down and restarting the hardware component or software package that is causing the failure, or even changing its protocol operation. If it is not able to resolve the problem automatically, the system reports the failure to the operator through visual indicators on the control interface.

Control system to report a failure