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Remote Control User Interfaces for Service Mobile Robots for Elderly Care

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Abstract: The following article discusses iPad and windows based user interfaces used to manage mobile robot for elderly care. Describe are specific areas like robot control, objects manipulation, task execution and real time robot status handling. Robot control discusses map handling, map navigation and manual robot handling and driving. Demonstrated are concepts like custom controls and virtual joysticks to manipulate robot. Object manipulation describes possible object related tasks and the way to execute them as well as getting feedback after task successful execution or failure. Task execution describes tasks, actions and action sequences. Also some safety and usability issues are evaluated.

Keywords**:** iPad, User Interface, Service Robotics, Windows Based Tablet

1. INTRODUCTION

Worldwide the elderly population is growing progressively. This raises problems like “How do we provide care for them?” and “How can they stay living in their homes as long as possible?”, which impacts the quality of their life and their relatives' lives. Nowadays, solutions which provide care-giving robots for servicing elderly people are becoming very suitable. Before any robot can be designed and built, the most basic problem is how we can control this robot remotely, safely and efficiently from relatives or professional caregivers. Resolving this problem means selecting best strategy for utilization of speech, gestures and touch control of the robot. Therefore emergence of the new tablet devices like Apple’s iPads (Apple) gives an opportunity to explore and implement better, easier, and friendlier human-robot interfaces (HRI). Such examples are multi-touch interfaces that improve human-robot interaction for single robot teleportation and multi-robot command and control. This is particularly valuable for supporting novice users and reducing training time in domains such as assistive robots.

2. STATEMENT OF THE PROBLEM

The development of the remote user control strategy for service robots for elderly care depends heavily on the operator’s spatial perception and interactions. The operator’s perception of the depth, distance, orientation, and configuration of objects are particularly essential to how the remote UI control system will respond to directives from the operator.

To design a robust remote UI control system for service robots for elderly care we must first take into consideration:

- How the operator perceives the location and orientation of objects
- How the operator interacts with objects
- The interplay between the operator and the simulated control system
- What level of automation allows the operator the best control and flexibility
- How to provide effective feedback to the operator from the robot

By studying these issues we will be able more effectively to explain and to predict the interactions between the operator and the service robots for elderly care. An additional challenge which needs to be addressed is the issue of user safety. When the operator gives the robot a command it is expecting the robot to carry out that task without injuring elderly people and without damaging the objects it is manipulating (Qiu, 2012). Another important thing is that our robot must be programmed in such way that it is safe for its operator and its surrounding. This means, even in manual operating mode the platform must take precautions and prevent any actions which will result in any damage not just to it but to its environment. Now, we are going to explain how we solved those problems.

3. iPad BASED USER INTERFACE FOR SERVICE ROBOTS FOR ELDERLY CARE

iPad based UI is a multi-touch tablet based mobile user interface for interaction between private care giver or relatives and robots for elderly care (Radev, 2011). Multi-touch interfaces improve human-robot interaction for single robot teleoperation and multi-robot command and control. This is particularly valuable for supporting novice users and reducing training time in domains such as service robots for elderly care.

Emergence of the new tablet devices like Apple’s iPads gives an opportunity to explore and implement better, easier and friendlier human-robot interfaces.

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3.1 Maps and map manipulation

Remote handling and manipulation of robots requires additional perception of the surrounding environment. That is why it is important to present to the user detailed information including surrounding objects, obstacles and available paths from one location to another.
It is important to allow additional interaction like zooming in and out the map using multi-touch gestures like pinch. These way user expectations for consistent and predictable behavior of applications are met (Fig. 1).

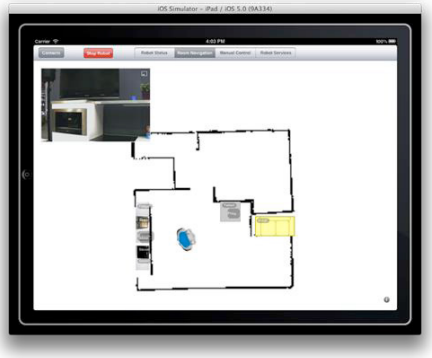

Fig. 1 Maps visualization

3.2 Virtual joysticks

The interface uses multi touch joystick, consisting of trigger. To move the robot, the user must press and hold the trigger, so that if the joystick is accidentally pushed, the robot will not move.
The robot is controlled by pressing the trigger and pushing in the direction of desired motion. Full mixing of translation and rotation is provided. It is also important to provide separate rotation control by implementing dedicated gesture only for this function (Fig. 2).

Fig. 2 Virtual joystick

3.3 Object manipulation

As we have discussed touch is emotionally important to humans; it conveys the identity and "realness" of an object. Direct touch bypasses abstraction and creates a strong connection with the touched object. That is why it is useful to provide context based actions when object is selected. These actions can be move, detect, find or any other that is associated with the object (Fig. 3).

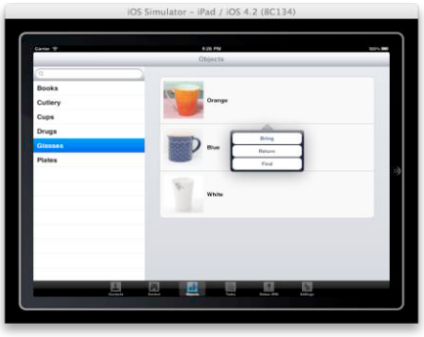

Fig. 3 Object manipulation and context menus

3.4 Task execution

Tasks define set of actions executed by the robot. Anything from "Open the front door", "Cook meal" to "Get milk" is consider as a task. By providing automation for executing complex task we provide remote users with simple, obvious interface, which would help them with everyday robot control (Fig. 4).

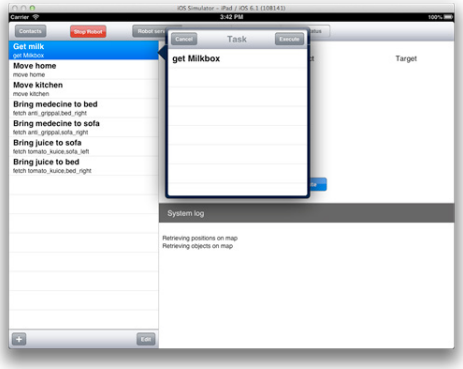

Fig. 4 Task lists and execution

3.5 Status handling

Since the robot is handled remotely it is important to provide status update in real time. Robot status screen provides the following information: Provides overview of the current active map as well as robot position; Activity log - Shows the latest activity or notification message from the robot; Power meter; Connection level; Last learned objects.
Tasks results, errors and error handling must be presented to the user in clear way so that he can react according to the status and handle it appropriately.