Multi-touch Interface for Controlling Multiple Mobile Robots

Igarashi Laboratory, The University of Tokyo
JST, ERATO, IGARASHI Design UI Project

Jun Kato
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INTRODUCTION
Motivation

• Multiple mobile robots can do various tasks with greater efficiency.

• They also improve fault tolerance.
• Then, how would you like to control movements of those robots?
  – “Discussion of Challenges for User Interfaces in Human-Robot Teams” - (Driewer, F., 2007)
Existing User Interfaces

- Joystick
- Mouse
- Gesture
- Speech

Gesture and Speech (Rogalla, 2002)  PDA and Pen (Fong, T., 2002)
Existing User Interfaces

Drawing a sketch to control robots (Skubic, M., 2007)
Problems

• Draw similar paths? Switch among many views?

• How can we combine these interfaces with autonomous approaches?
My Approach

God’s view of the environment

Two hands’ intuitive operation

Direct manipulation of raw data for navigating robots
Draw a stream, drift robots!
Multi-touch Interface for Controlling Multiple Mobile Robots

VECTOR FIELD OPERATION
Hardware Setup

Ceiling-mounted camera

Multi-touch display

Wirelessly connected Bluetooth

Mobile robots

PC

with

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Vector Field on the View

- The view is divided into grids.
- Each grids have 2D vector information.
- Whole grids construct a 2D vector (flow) field.
Available Operations on the Vector Field

To move robots,

Drag

To fix movements,

Mix

To stop robots,

Hold
Implementation of the Vector Field

Capture

Calibrate

Track motion

Vectors are overwritten completely in **blue** area

Motion vector affects the field

Vectors are overwritten 0-100% in **green** area, in proportion to the distance from the center
“So, what can we do?”
Next Step...

- A user test
- Integration of other user interfaces
Combination with Direct Operation

- Based on Vector Field Operation
- When fingers are in the robot icon, Direct Operation starts.
  - The robot under the finger moves along the path it draws.
Extensions of Vector Field Operation

- Draw or clear virtual walls.
- Draggable virtual dog icons. Robots as sheeps run away!
- Bind relative positions of robots
Integration with Autonomous Algorithms

• With Virtual Force Field (Borenstein, J., 1989)
• Etc.?
Extensions of Visualization

Visualization of the Vector Field with particle-animation

Error displays like time out

Path calculation and visualization

I can’t move!

Destination!

My path!
Summary

- We developed a multi-touch interface for controlling multiple mobile robots simultaneously.
- Our interface has capability to be integrated with other operating methods, including autonomous ways.