

Multi-touch Interface for Controlling Multiple Mobile Robots

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

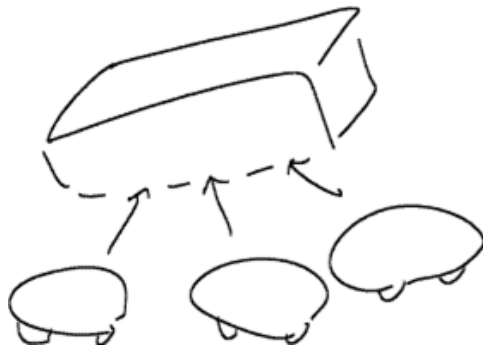
 Jun Kato

A decorative graphic consisting of several overlapping, wavy, horizontal bands in shades of light blue and green, positioned in the upper half of the slide.

Multi-touch Interface for Controlling Multiple Mobile Robots

INTRODUCTION

- 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)
 - “Human control for cooperating robot teams” – (Wang, J., 2007)

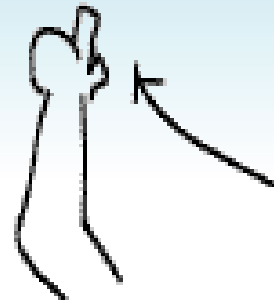
Existing User Interfaces



Joystick



Mouse



Gesture



Speech

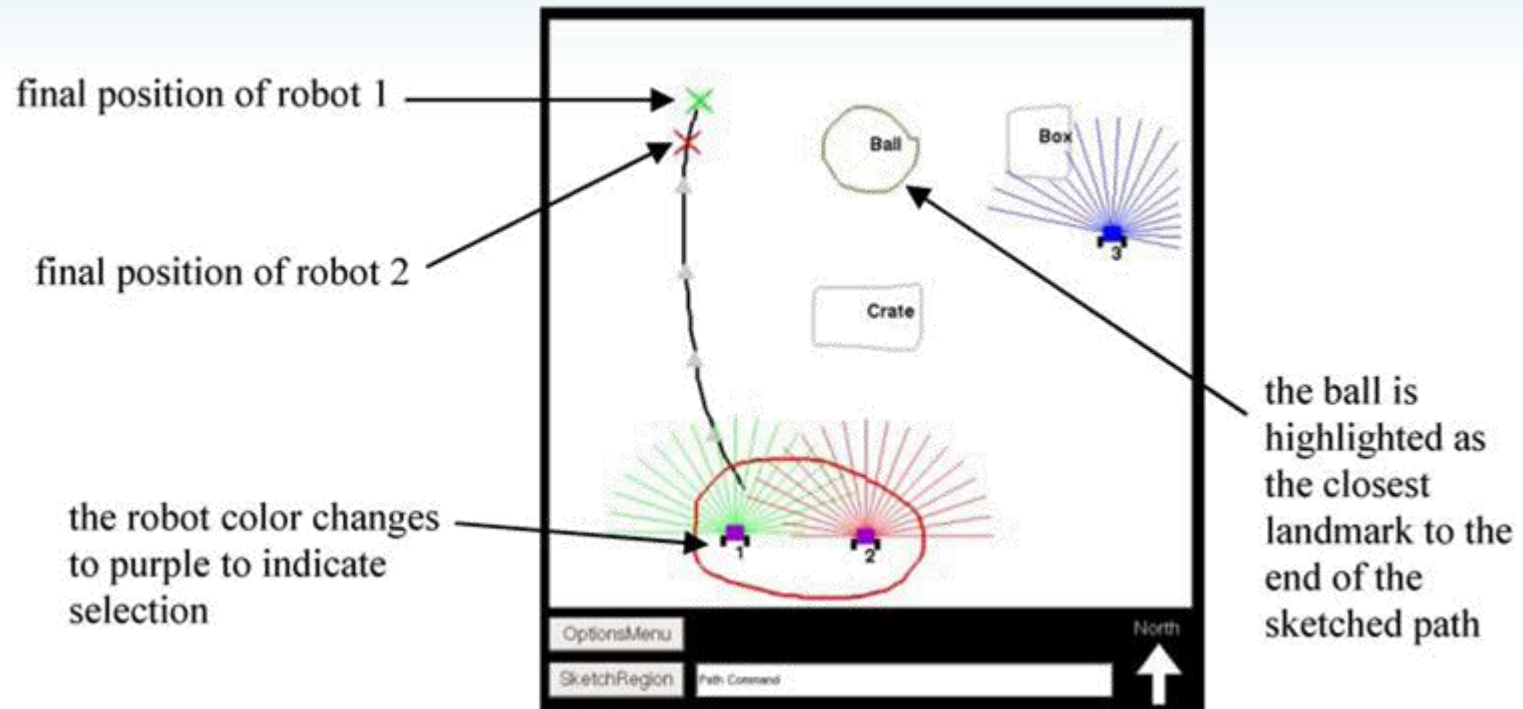


Gesture and Speech (Rogalla, 2002)



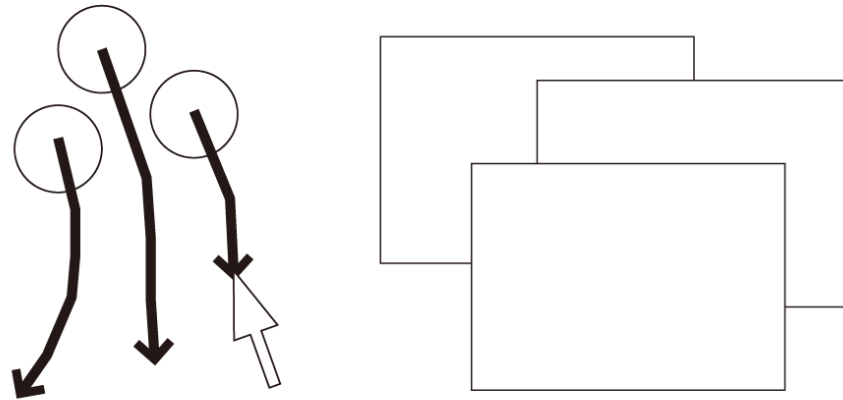
PDA and Pen (Fong, T., 2002)

Existing User Interfaces



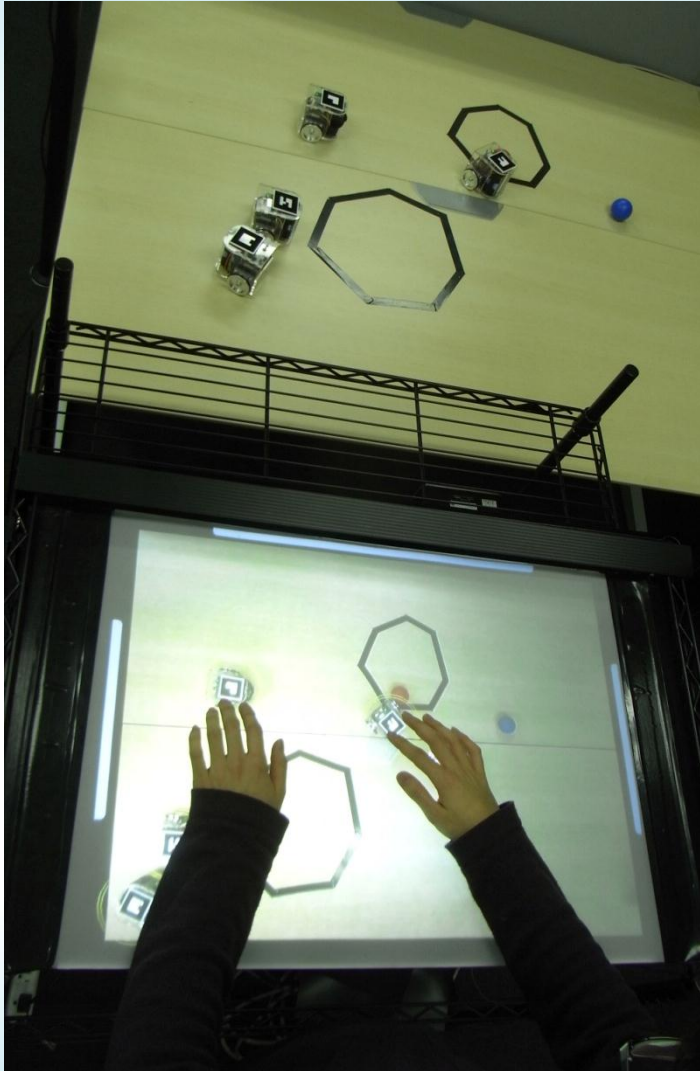
Drawing a sketch to control robots (Skubic, M., 2007)

- Draw similar paths? Switch among many views?



- How can we combine these interfaces with autonomous approaches?

My Approach



God's view of the environment

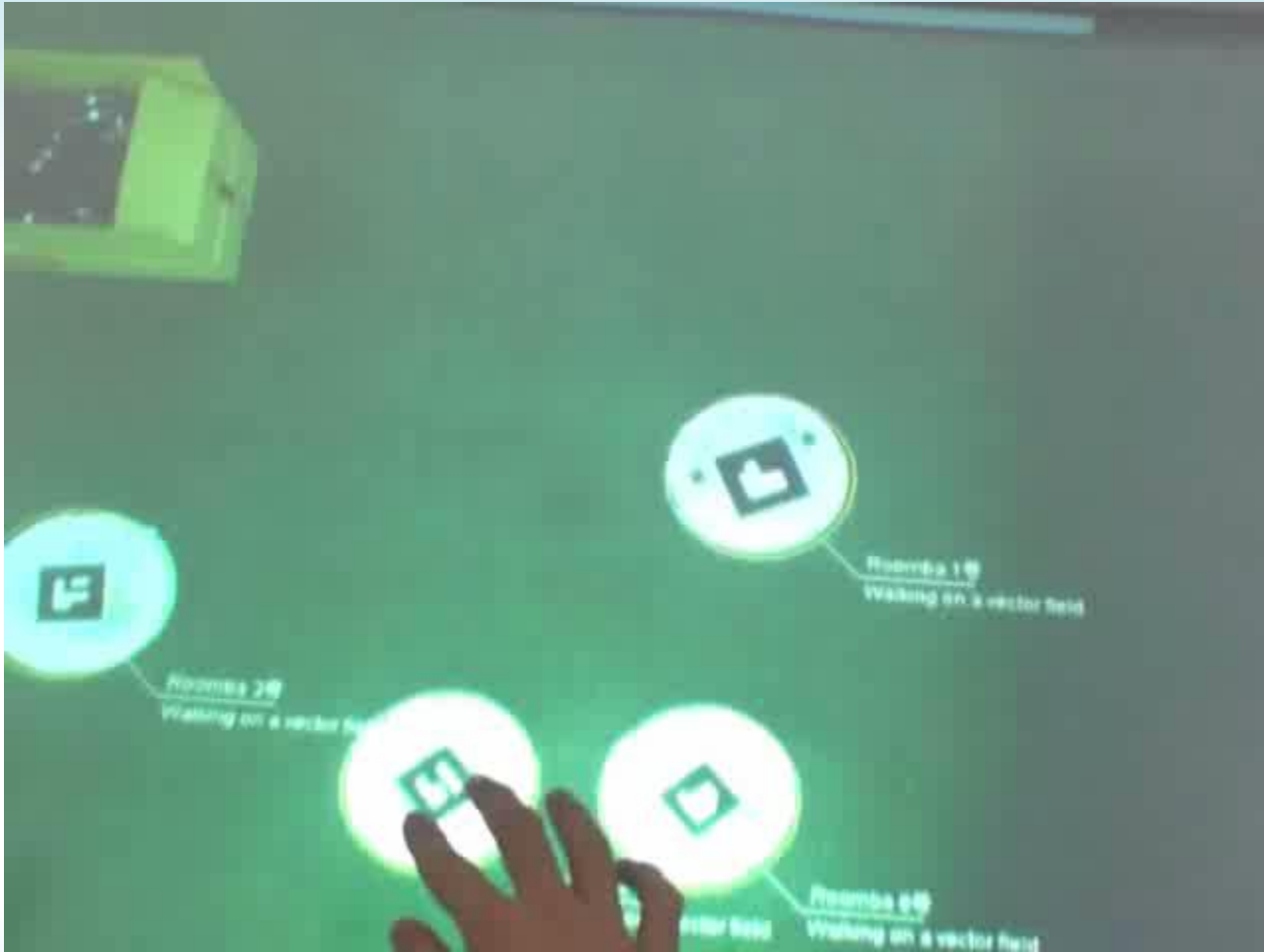


Two hands' intuitive operation



Direct manipulation of raw data
for navigating robots

Vector Field Operation



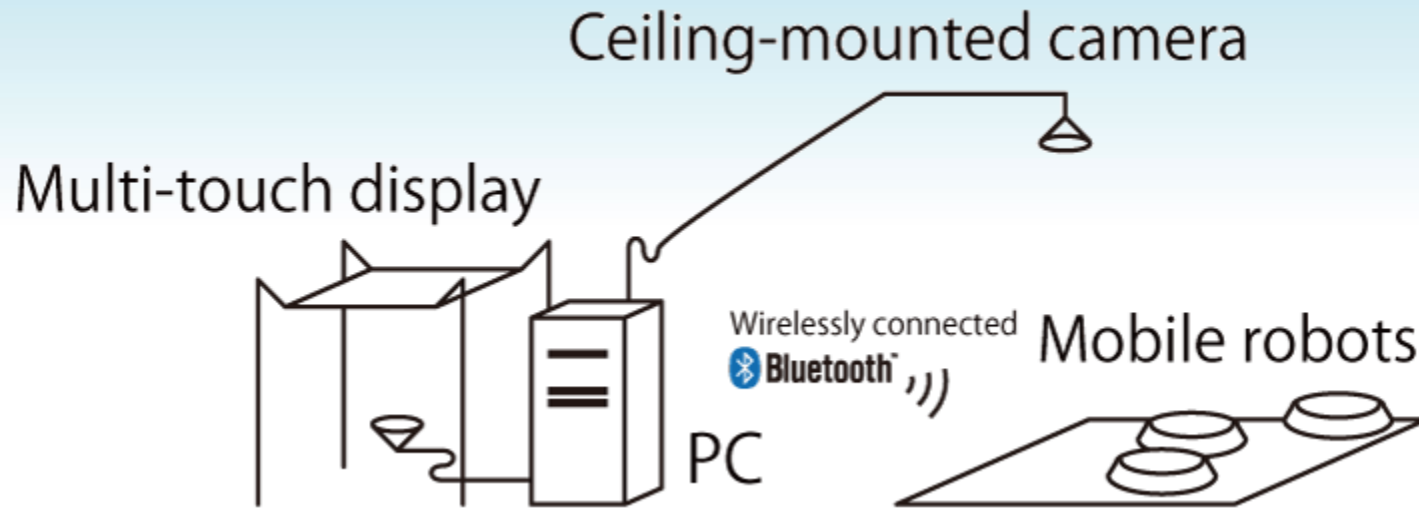
Draw a stream, drift robots!



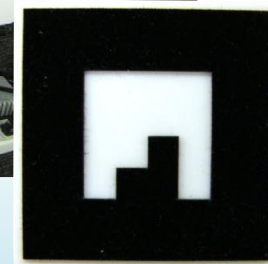
Multi-touch Interface for Controlling Multiple Mobile Robots

VECTOR FIELD OPERATION

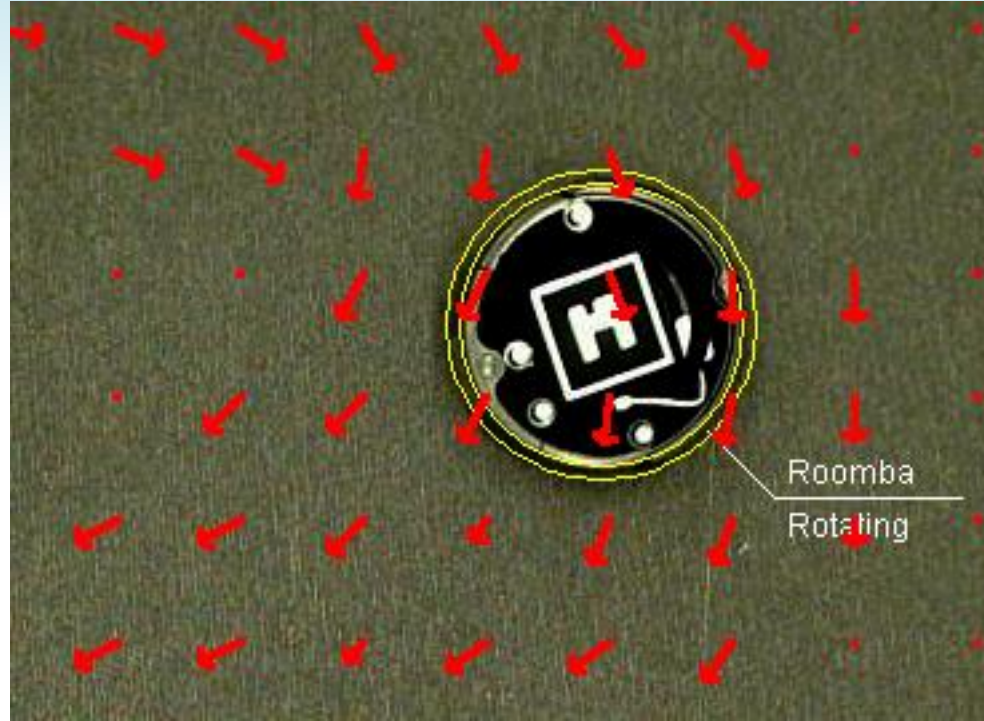
Hardware Setup



with



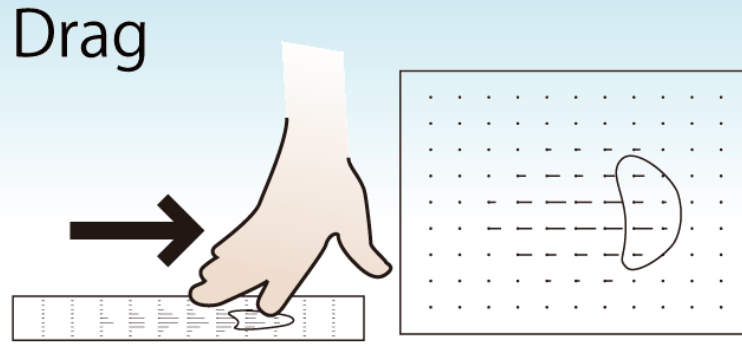
Vector Field on the View



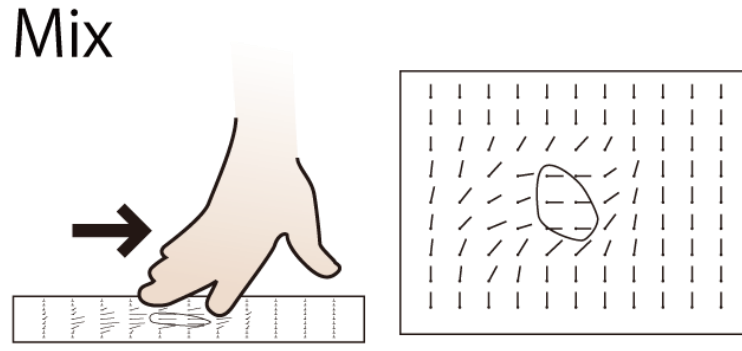
- The view is divided into grids.
- Each grids have 2D vector information.
- Whole grids construct a 2D vector (flow) field.

Available Operations on the Vector Field

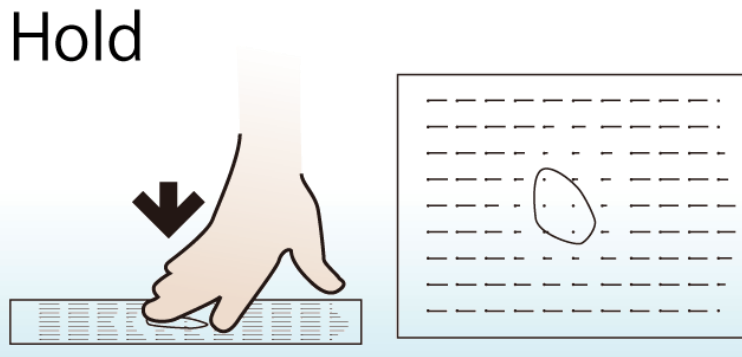
To move robots,



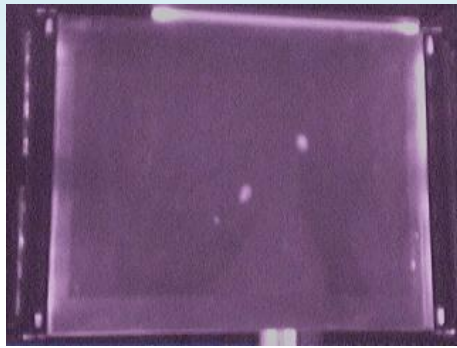
To fix movements,



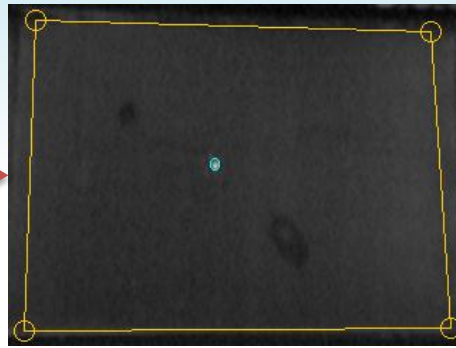
To stop robots,



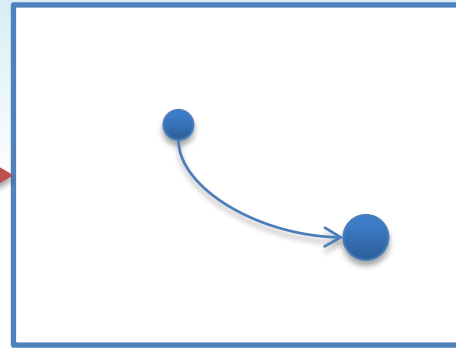
Implementation of the Vector Field



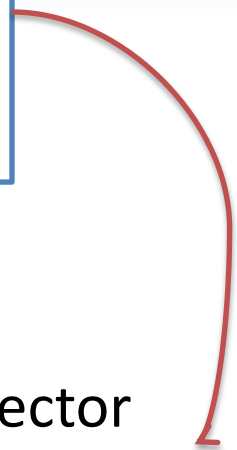
Capture



Calibrate



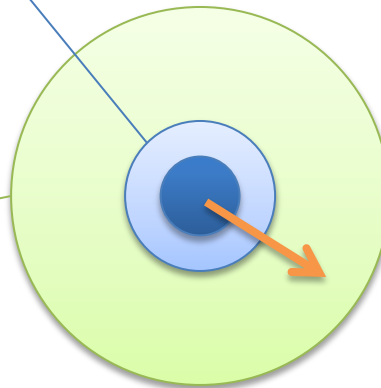
Track motion



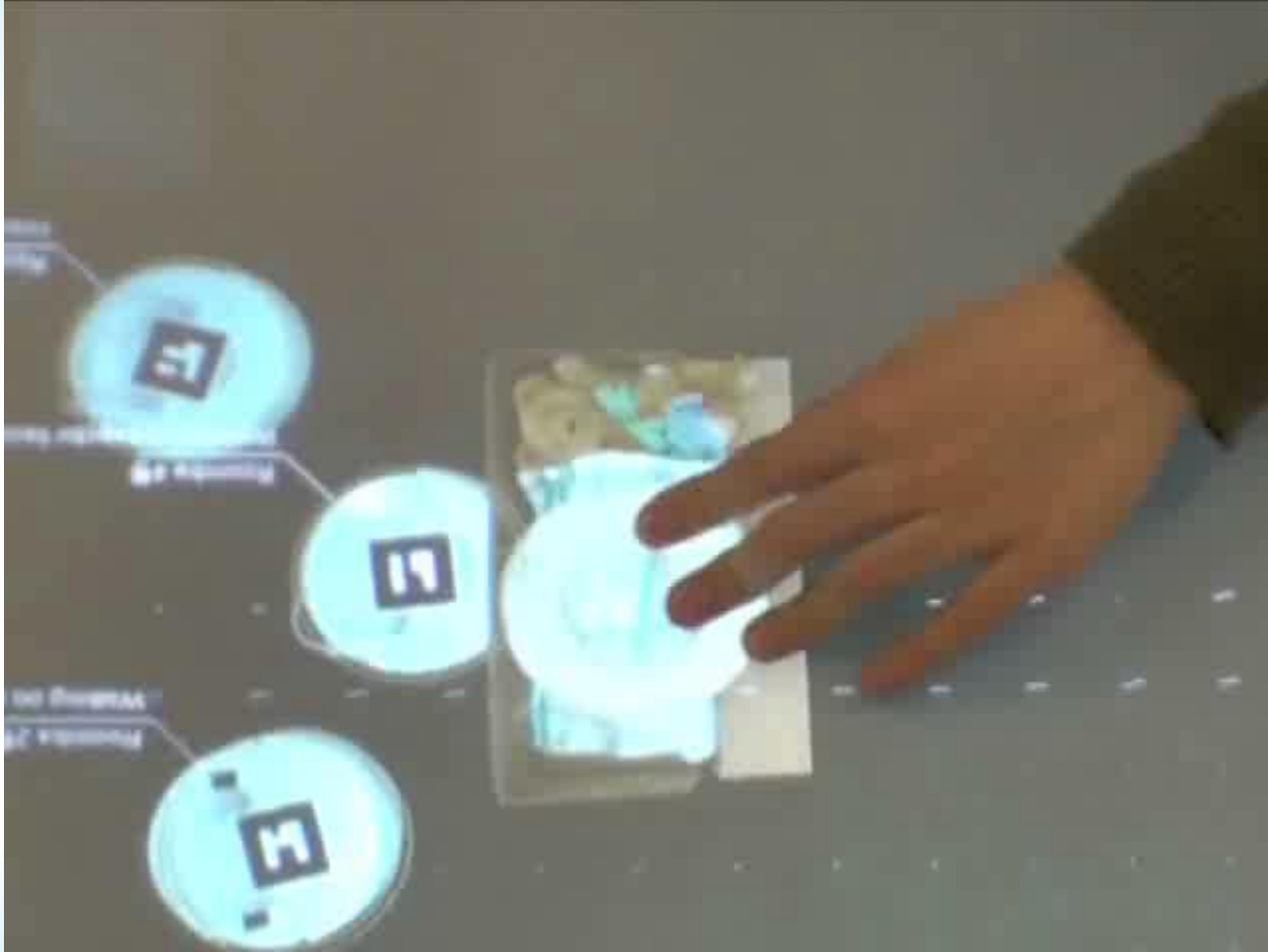
Motion vector affects the field

Vectors are overwritten completely in **blue** area

Vectors are overwritten 0-100% in **green** area, in proportion to the distance from the center



 “So, what can we do?”



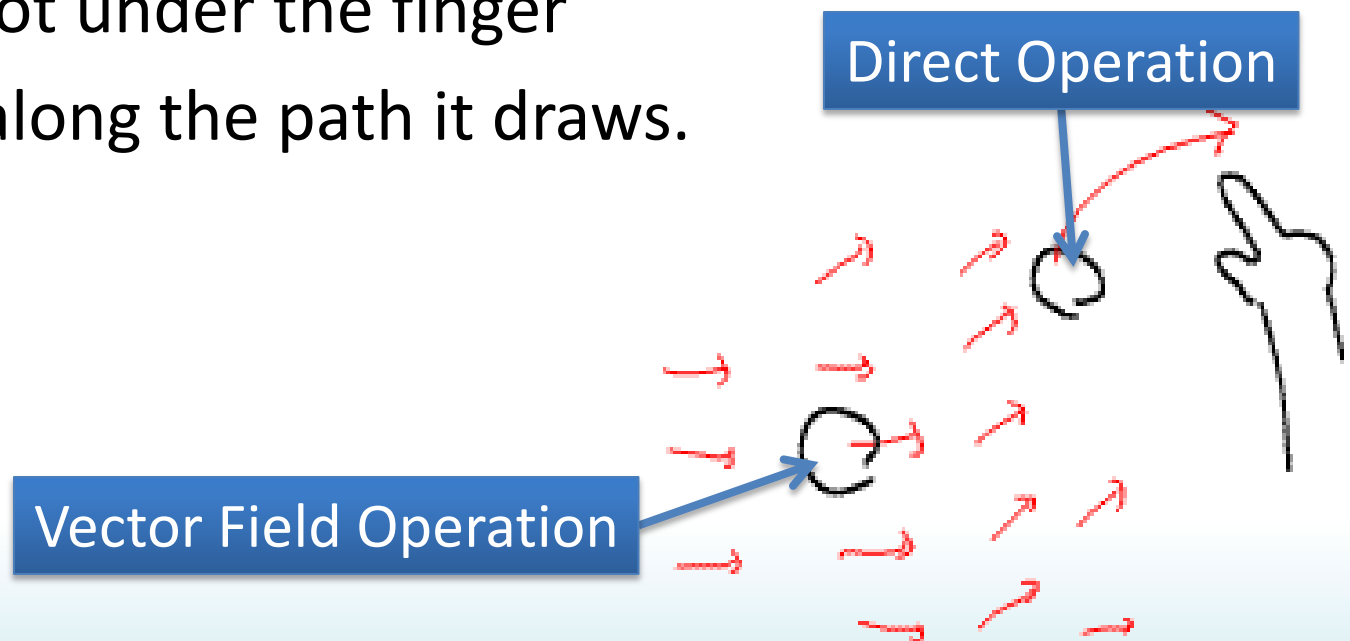


Next Step...

- A user test
- Integration of other user interfaces

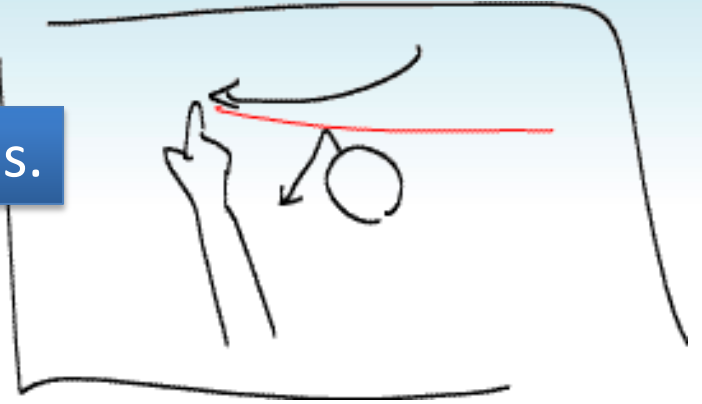
Combination with Direct Operation

- 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.

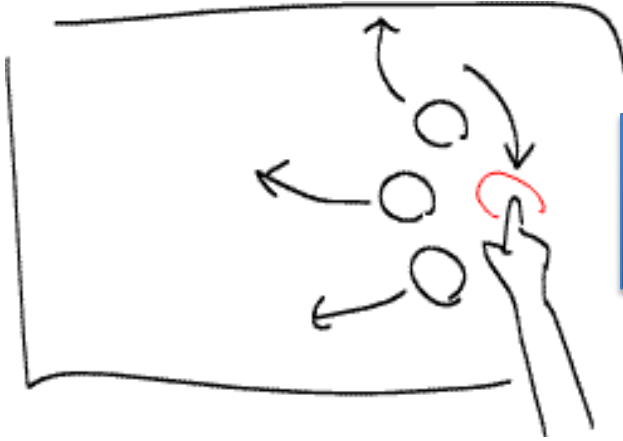


Extensions of Vector Field Operation

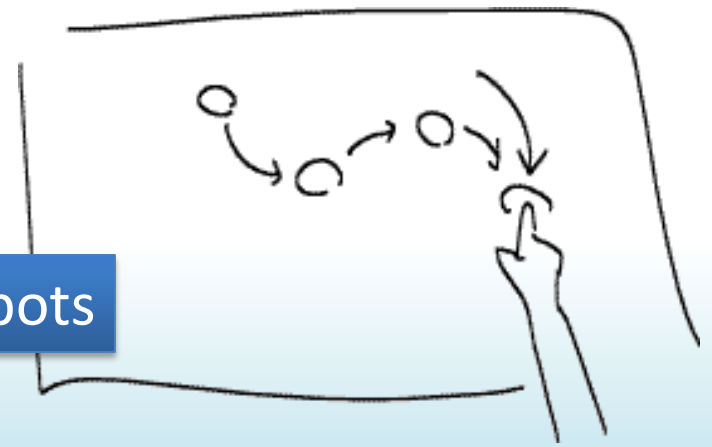
Draw or clear virtual walls.



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



I can't move!

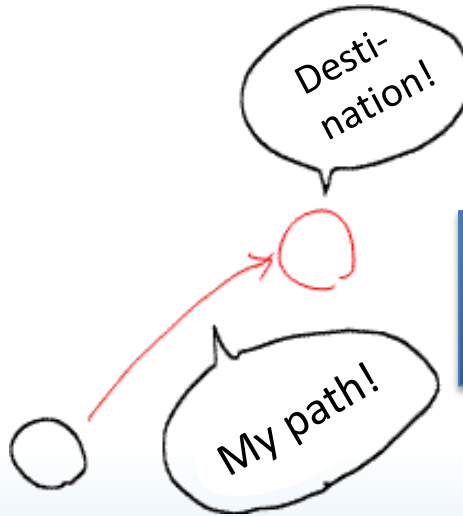


Error displays
like time out

Desti-
nation!

My path!

Path calculation
and visualization



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.

