A Framework for Robust and Flexible Handling of Inputs with Uncertainty

Julia Schwarz, Scott Hudson, Jennifer Mankoff

julia.schwarz@cs.cmu.edu

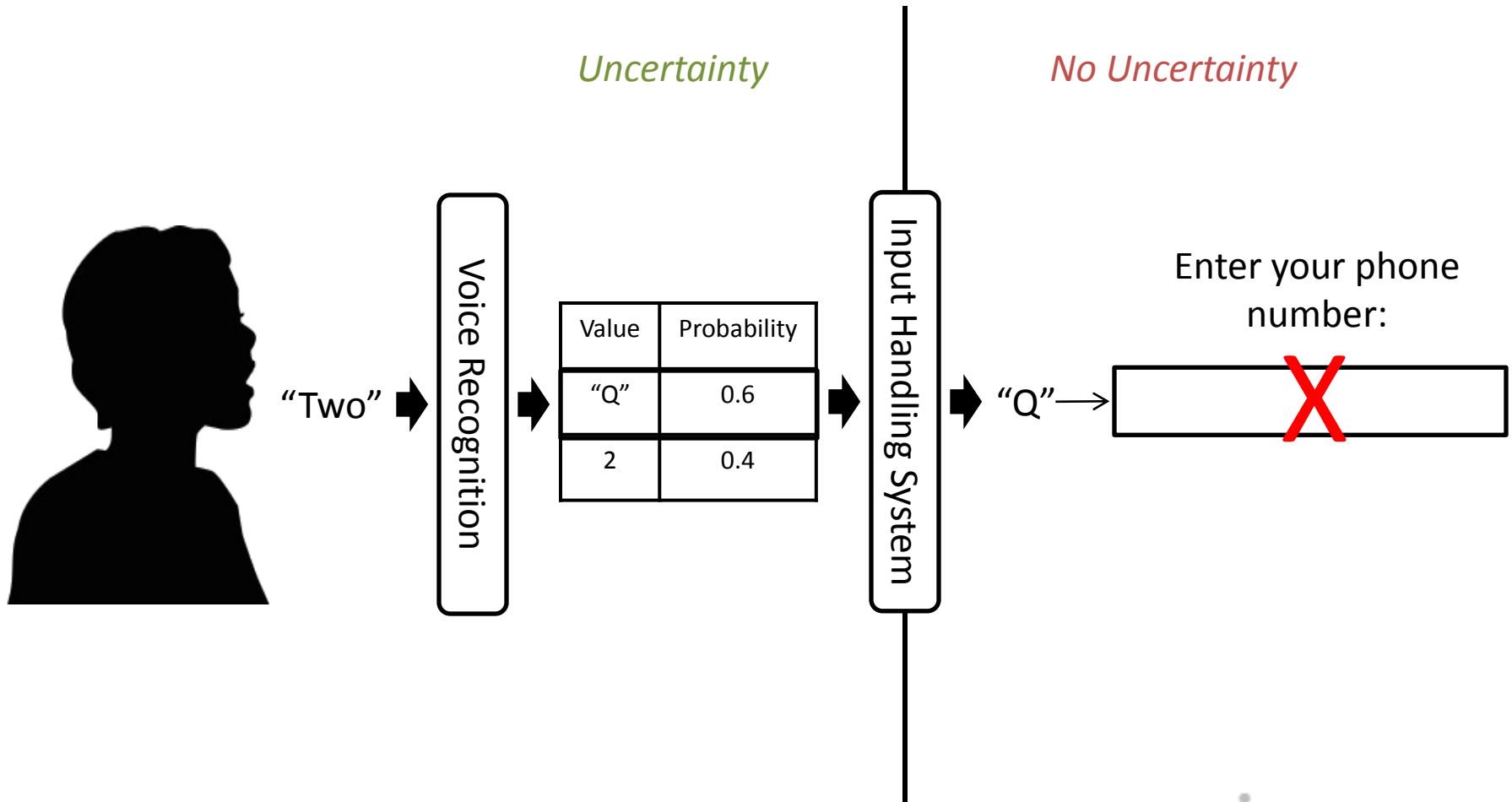jmankoff@cs.cmu.edu

scott.hudson@cs.cmu.edu

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Problem

Current framework quickly resolves uncertainty

Small interpretation errors -> big problems

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Filling out a Form

Uncertainty | No Uncertainty

Voice Recognition

"Two"

Value	Probability
"Q"	0.6
2	0.4

Input Handling System

"Q" →

Enter your phone number:

X

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Example: Touch

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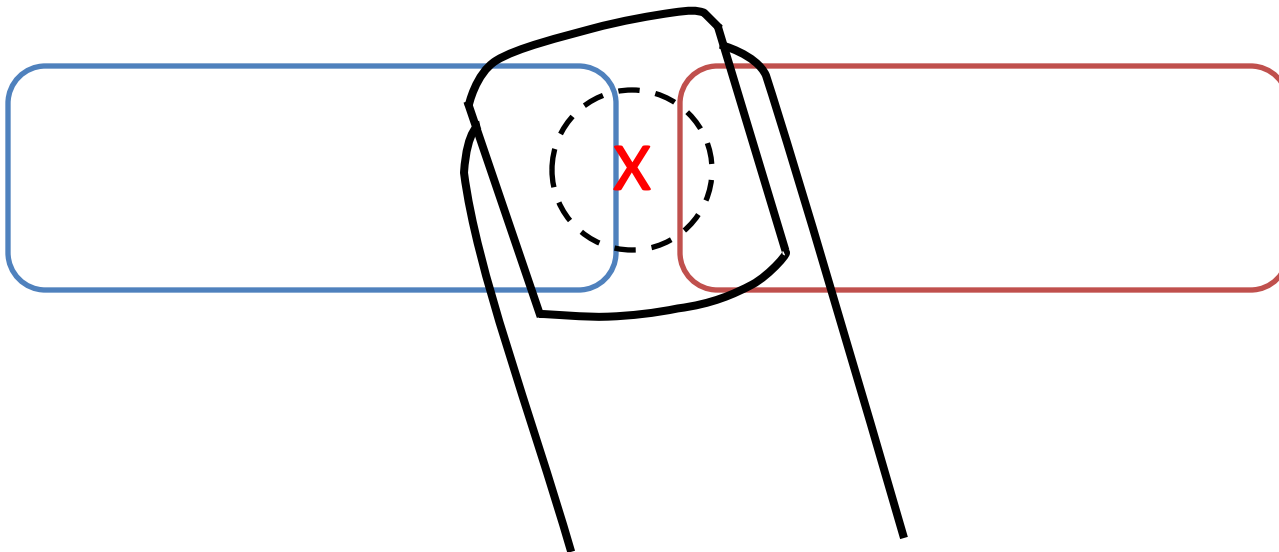
Current Solutions

Use evidence from multiple modalities
to disambiguate [Oviatt '99]

Ad-hoc solutions

Contact area interaction [Moscovich '09']

Bubble cursors [Grossman '05]

Error correction in speech [Ainsworth '92]

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Contribution

Developed framework to handle uncertain inputs

    Modeling of uncertain input

    Dispatch process to determine who should handle event

    System for resolving conflicting actions

Illustrate interaction improvements

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Example Interactions

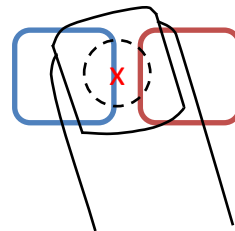# Conventional Input vs. Probabilistic Input
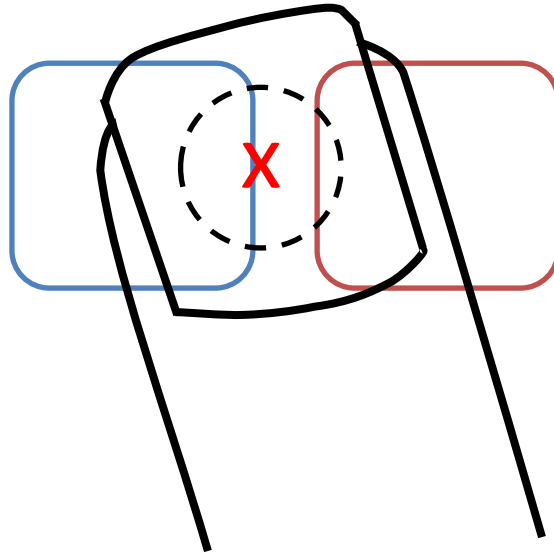
Conventional Input vs. Probabilistic Input
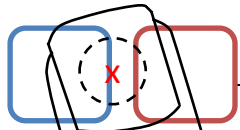
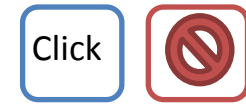1. Modeling   2. Dispatch   3. Action   4. Mediation

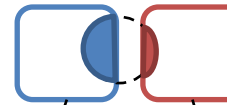Conventional

Touch Down
(x,y)

Nobody

No Action

N/A
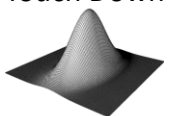
Probabilistic

P = 0.4   P = 0.1
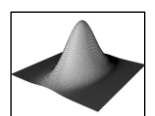
Touch Down
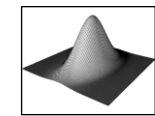
Touch Down

Touch Down

Action Request
p = 0.4

Action Request
p = 0.1

Click
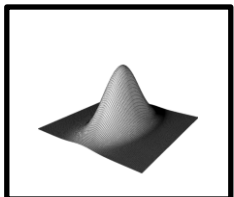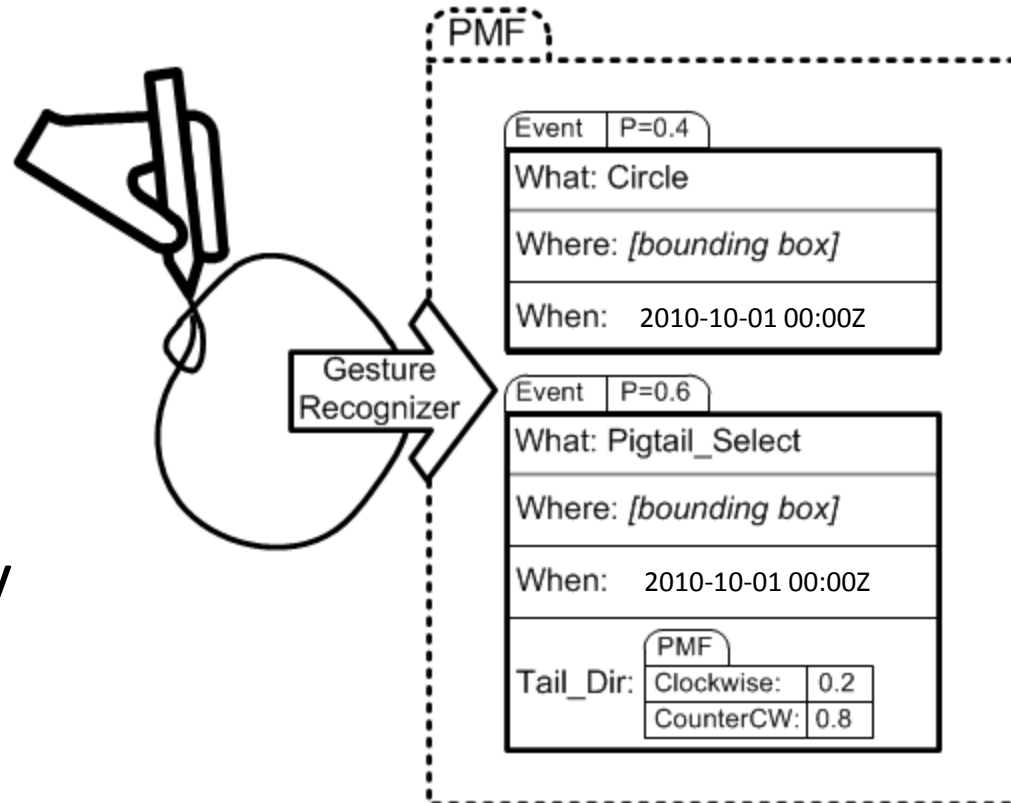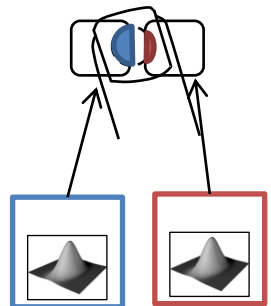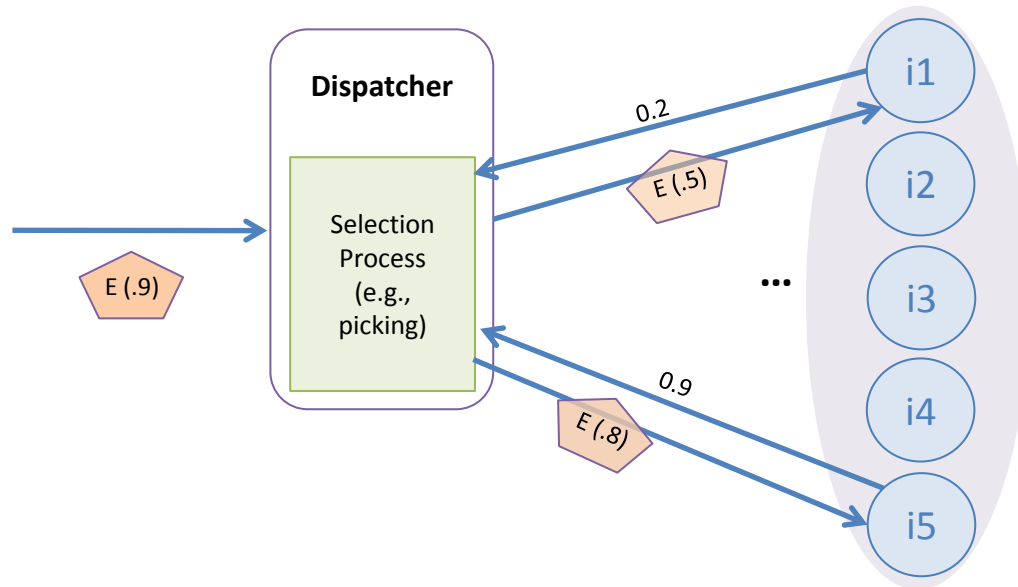
System Description
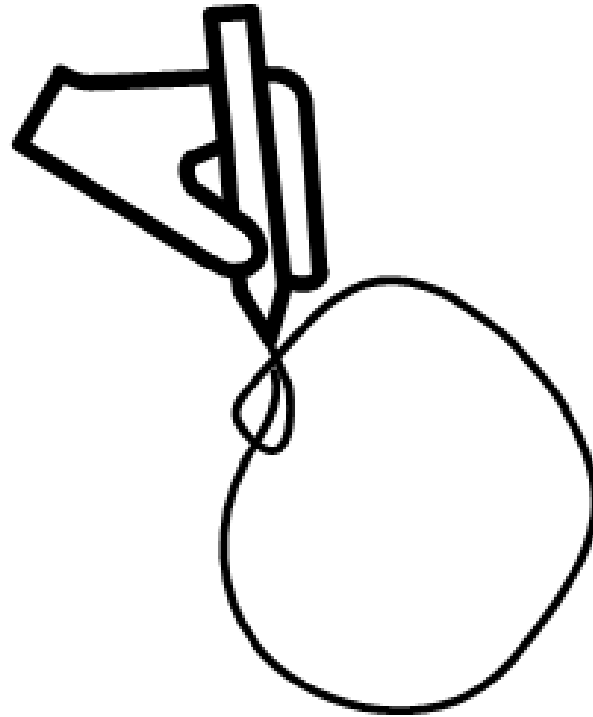
1. Modeling

Multiple interpretations

Each event has its own probability

Multiple properties

Each property is Probability Mass Function (PMF)

PMF

Event	P=0.4
What: Circle	
Where: *[bounding box]*	
When:	2010-10-01 00:00Z

Event	P=0.6
What: Pigtail_Select	
Where: *[bounding box]*	
When:	2010-10-01 00:00Z

Tail_Dir:	PMF	
	Clockwise:	0.2
	CounterCW:	0.8

Gesture Recognizer

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2. Dispatch
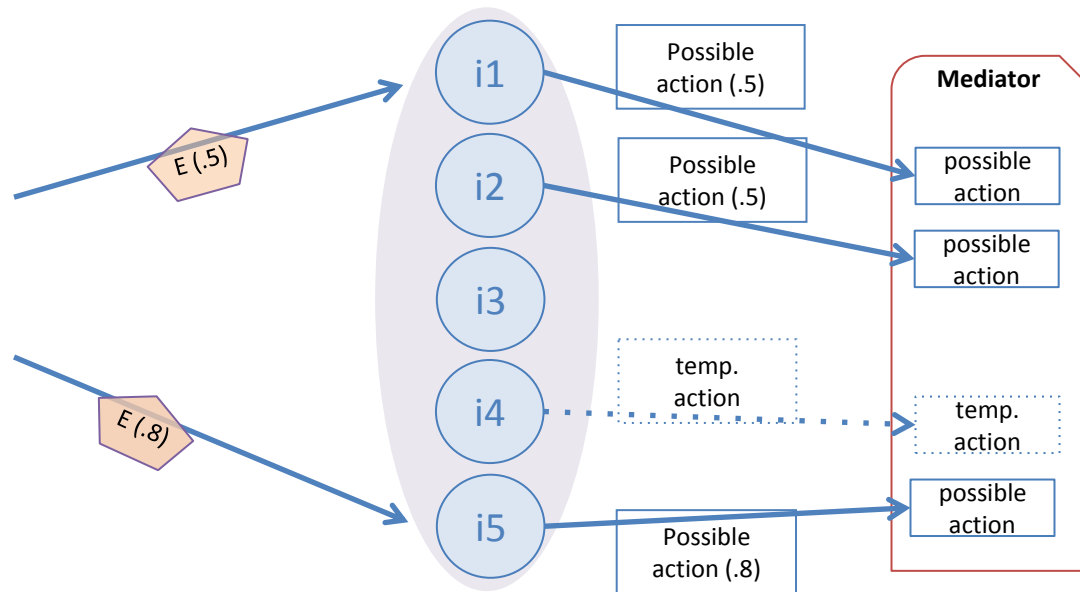
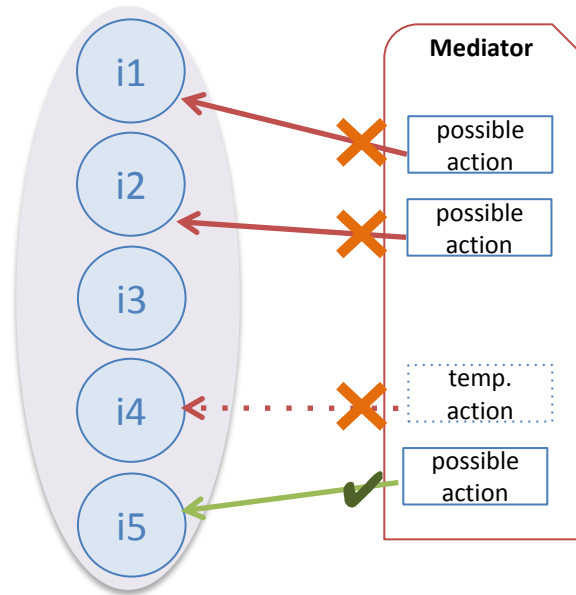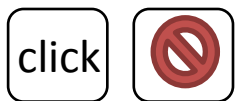# 3. Action

4. Mediation

[Mankoff et al. '00]

click

15

Wide Applicability

Traditional uncertain input

 Voice, Touch, …

New Possibilities

 User error

 Predicting intent
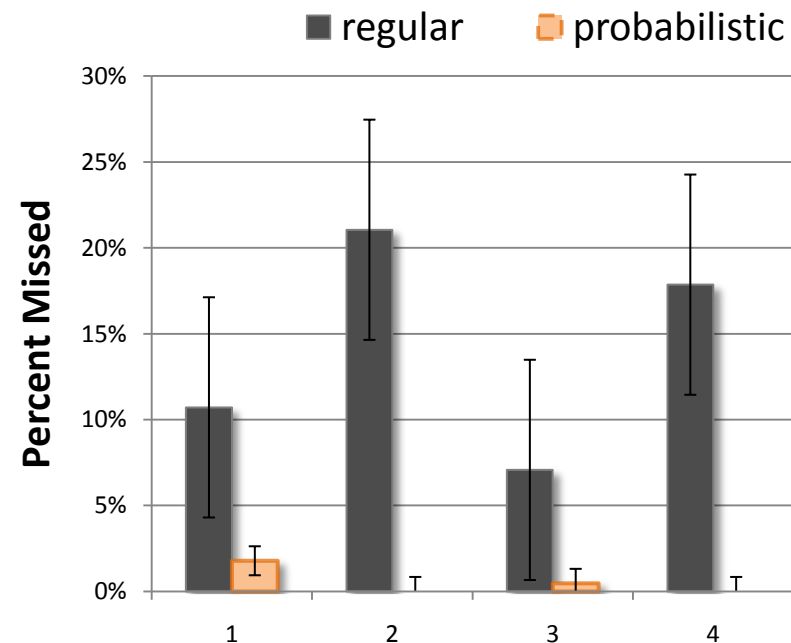
 …

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User Error: Helping People with Motor Impairments

When using a mouse, click location not equal to intent

Model click as PMF

Collected data:
100+ clicks x 4 users

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Summary

Developed framework for handling inputs with uncertainty

Unified architecture supports a number of existing solutions

Opens up new possibilities

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Future Work

Track interactor state probabilistically

Manage conflicting intermediate feedback

Develop deployable toolkit

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Questions?

IIS-0713509, IIS-0803733, and IIS-0840766

The ARCS Foundation