HNI: Human network interaction

Ratul Mahajan

Microsoft Research

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I am a network systems researcher

Build (or improve) network systems

• Build tools to understand complex systems

View system building as the art of balancing technical, economic, and business factors

• And off late, human factors too

This talk

Three case studies

- Network diagnosis
- Network monitoring
- Smart homes

Diagnosis explains faulty behavior

Starts with problem symptoms

Ends at likely cause(s)



Key considerations for diagnostic systems



Accuracy: How often the real culprit is identified Coverage: Fraction of failures covered

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NetMedic: A detailed diagnostic system

Focus on small enterprises

Inference based:

- Views the network as a dependency graph of finegrained components (e.g., applications, services)
- Produces a ranked list of likely culprit components using statistical and learning techniques

Effectiveness of NetMedic



The real culprit is identified as most likely 80% of the time *but not always*

Unleashing NetMedic on operators

Key hurdle: Understandability

- How to present the analysis to users?
- Impacts mean time to recovery



Two sub-problems at the intersection of systems and HCI

- Explaining complex analysis
- Intuitiveness of analysis

Explaining diagnostic analysis

Presenting the results of statistical analysis

- Not much existing work; this uncertainty differs from that of typical scientific data
- Underlying assumption: humans can double check analysis if information is presented appropriately

An "HCI issue" that needs to be informed by system structure





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[NetClinic: Interactive Visualization to Enhance Automated Fault Diagnosis in Enterprise Networks , VAST2010]



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Intuitiveness of analysis

The ability to reason about the system's analysis

- A non-traditional dimension of system effectiveness
- Counters the tendency of optimizing the system for incremental accuracy



A "systems issue" that needs to be informed by HCI

Intuitiveness of analysis (2)

Goal: Go from mechanical measures to more human centric measures

• Example: MoS measure for VoIP

Factors that may be considered

- What information is used?
 - E.g., Local vs. global
- What operations are used?
 - E.g., arithmetic vs. geometric means



Considerations for diagnostic systems

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Network Alarm Monitoring and Triage



Network

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Key considerations for triage systems



CueT: Cooperating machine and human

Use interactive machine learning to automatically learn patterns in operators' actions



[CueT: Human-Guided Fast and Accurate Network Alarm Triage, CHI 2011]

CueT is faster and more accurate



50% speed improvement

10% accuracy improvement

Unleashing CueT on operators

Key hurdle: predictable control

- Predictability in system actions and recommendations
- Unlearning bad examples
- Direct control for special cases



Considerations for network alarm triage

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Smart homes

Capability to automate and control multiple, disparate systems within the home [ABI Research]



Why are smart homes not mainstream?

The concept is older than two decades

Commercial systems and research prototypes exist

Initial hypotheses

- Cost
- Heterogeneity

Study of automated homes

To understand barriers to broad adoption 14 homes with one or more of:

- Remote lighting control
 Multi-room audio/video systems
 Security cameras
- Motion detectors





[Home automation in the wild: Challenges and opportunities, CHI 2011]

Four barriers to broad adoption

1. Cost of ownership

2. Inflexibility

3. Poor manageability





4. Difficulty achieving security





Some implications for research

Let users incrementally add functionality

While mixing hardware from different vendors
 Simplify access control and guest access
 Build confidence-building security mechanisms

Theme: Network management for end users

• Current techniques are enterprise heavy

HomeOS: A hub for home technology



[The home needs an operating system (and an app store), HotNets 2010]

Status



.NET-based software module

- ~20K lines of C# (~3K kernel)
- 15 diverse apps (~300 lines per app)

Positive study results

- Easy to manage by non-technical users
- Easy to develop apps

Small "dogfood" deployment Academic licensing – What would YOU do?



Considerations for smart homes

HNI: Human network interaction



Networks are (often loosely) coupled computing devices

• Interactions are more complex and challenging

Users are increasingly exposed to the complexity of networks Human factors can be key to acceptance and effectiveness

• Must work with realistic models of network systems

Summary

- Human factors can be key to the success of network systems
 - Their impact on the design can run deep

The complexity of network systems opens up new challenges for HCI research