Human Information Interaction that transcends the desktop

**Information Appliances**
- Develop novel room-based and portable information appliances
- Develop protocols for appliance discovery and for configuring virtual controls
- Develop software to manage interactive information walls

**Activity Recognition**
- Develop multi-modal algorithms for sensing people, gestures, and intents
- Develop multi-media gisting and meta-data extraction techniques for summarizing activities

**Personal Information Projection**
- Develop techniques for projecting personal information from cyberspace into smart spaces
Smart Spaces
Novel Room-based Information Appliances

Virtual Sliding White Board

MEMs-based Active Surface

Active Easel

Duo Workstation
Smart Spaces

Novel Portable Information Appliances

Foldable Computers

Computer, Projector & Camera in One

Digital Ink

Handheld Media Board

Smart Paper
Prototype Smart Space

Monitors, Cameras, VCRs, Computers, A/V Switches, Echo Canceller, Scan Converters, Serial Muxes, LiveBoard, Speakers, Mic Amps, Receivers, Wireless LANs, . . .

List of Discovered Appliances

Map with Location of Appliances
Smart Spaces
Configuring Virtual Controls

THIS?

OR THIS?

Composable, Virtual Controls

--- Other ---

--- Routing ---

resynchronize matrix

--- test lights ---

--- EXIT ---

--- Audio ---

--- Video ---

--- Both ---
Smart Spaces
Interactive Information Walls

Remote Interactive Information Walls

Interactive Information Mural

New generation DMD/LCD projector

PC/PC-SMP with 3-D accelerators

Fast network switch

3 Pixel Image on Screen

Light Source
Projection Lens

Light Absorber

2 DMD Micromirrors (Side View)
(Actual Top View)

4:3 4:3
Smart Spaces
Sensing People, Gestures, and Intents

Hearing People
- Host PC: Calculates source coordinates from TDOA estimates, controls sensors and beamforming array.
- Line Array Hardware: Use programmable analog delay lines to perform beamforming and provide sound output.
- Canon VC-CL Camera

Seeing People
- Concept - Light Field Camera Wall
- Projection wall interspersed with low-cost, unobtrusive cameras
- Compression chip
- Imaging chip
- Light field compressed data network

Tracking People
- Video projector
- Hi-res video camera on pan-tilt head
- Omni cam panoramic camera
- Virtual pan
- Hi-res insert

Modeling Spaces

Acquisition
- Spherical Mosaicing
- Sparse Geometry Estimation
- Dense Surface Estimation
- Per-Facade Robust Texture Estimation
- 3D Points

Extraction
- Surface Control
- 3D Outlier Detection
- Aggregation
- Scene Interpreter

Facility
- Fully automated
- Semi-automated
- Under development

Key:
MIT City Scanning Project. System Overview Supervisor: Prof. Seth Teller. (March 1999)
Recognizing Speakers and Detecting Topics, People, Places, and Things

Detecting Faces and Associating Faces and Names

Generating Activity Descriptions

Integrating Multiple, Multi-modal Perspectives
Smart Spaces
Moving Through Smart Spaces

“city-wide appliances”

“in-building appliances”

“on-floor appliances”

Office: ITO
PE/Project: 
Pgm No.: 
Pgm Mgr.: Mills/Swinson
PAD No.: 

DARPA
**Smart Spaces**

**Personal Information Projection**

- **Microphone Array**
- **Interactive Information Wall**
- **Portable Notebook**
- **Desktop Computer**
- **Active Router**
- **Smart Space Server**
- **Multicast Channel**
- **Personal Information Server**
- **Personal Digital Assistant**
- **Active Router**

**DARPA**

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Smart Spaces
Commercial Application - Collaborative Design Space
Smart Spaces

2010: The Pentagon as Distributed Smart Spaces