Interactive System Design for Cooperative Work

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Overview

- Context
- Definitions, dimensions, and domains
- System design
- Interaction design
  - Augmentation and agents
  - Visualization
  - Information
- Agents design
- CASCADE – collaborative authoring

Context

- Distributed system architecture
  - Sockets >> RPC/RMI >> CORBA
  - Ubiquitous high speed access
- Personal workstations
  - 64th square machines
  - Desktop screen territory
- Digital information
  - Structured Documents, availability and acceptance
  - Mutli-view databases
  - Common interchange formats
- Network information
  - Directories
  - User Profiles

Definition

- What we now think of as Computer Supported Collaborative Work (CSCW) grew out of a much "simpler" concept of office automation.
- Academics distinguish the study of this process (CSCW) from specific applications which are often referred to a groupware.
- CSCW was initially divided into classes based on time and place.
- Much more sophisticated breakdowns are now possible as more sophisticated applications appear.

Dimensions

- Spatial Continuity
  - Same place
  - Distributed
- Temporal Continuity
  - Synchronous
  - Asynchronous
- Temporal Scope
  - Hour
  - Day or week
  - Month or year
- Artifact Sharing & Control
  - Individual
  - Token based
  - Fully shared
- Group Size
  - Small
  - Medium
  - Large
- Group Structure
  - Controlled
  - Hierarchical
  - Self-organizing
  - Democratic
- Artifact Types
  - Documents
  - Databases
  - Graphics
  - Processes

Selected Example Domains for Cooperative Work

- Work processes
  - Purchasing, accounts payable, application review
- Information stores
  - Help desk, product development
- Document processing
  - Reviewing code, proposals, articles
  - Authoring standards, proposals, legislation
- Meetings
  - brainstoming, planning, decision making
- Education
  - Curriculum development
  - Instructional delivery

Requirements Analysis

- System Functionality
  - Interaction and communication
  - Coordination of process and artifact
  - Distribution
  - User-specific needs
- Portability and Adaptability
  - Different hardware platforms, operating system, window systems, and graphical user interface.
  - Various audio, and video formats.

System Requirements

- Application support
  - Integrated
  - Plug-in
- Interaction modes
  - Text, audio, video
  - Public, private
- Coordination modes
  - Simple coordination
  - Token based control
  - Role based control
- Data sharing and data hiding
  - Artifact protections
  - User access rights
  - Public and private data

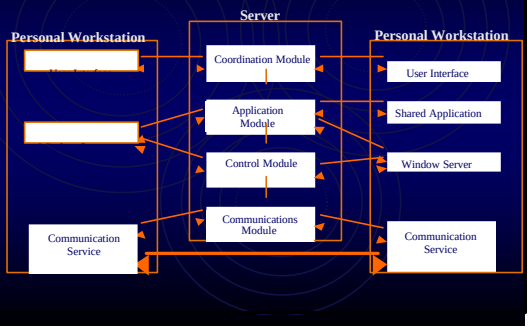
Typical Support Modules

- Coordination management provides support for:
  - Various types of sessions (closed, open, joinable)
  - Floor control policies (role based, queue based, assignable, open)
  - Artifact access and control
  - Process control (rule based, open)
- Control management provides support for artifact access and shared pointers
- Communications module provides support for communication

Application Strategies

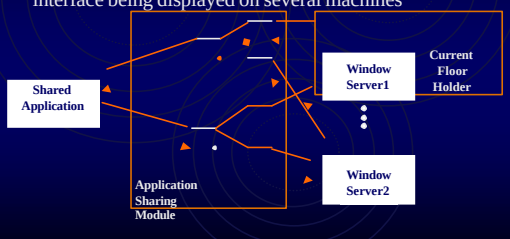
- Use unmodified single-user applications
  - Approach is independent of any application domain.
  - Users don't have to learn new applications for cooperative work.
  - Applications can be used without modifications
  - Hooks may not exist for shared control
- Design new group aware applications
  - Extensive coding required to provide commercially available and expected functionality
  - the known process can be engineered or reengineering for optimum efficiency

Centralized Model

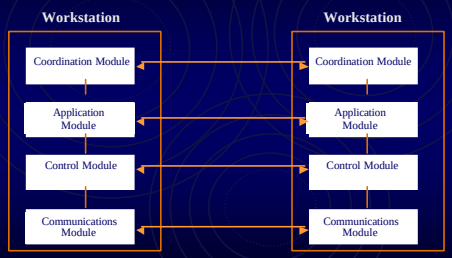


Centralized Application Sharing

- Application executing on one machine, and its user interface being displayed on several machines

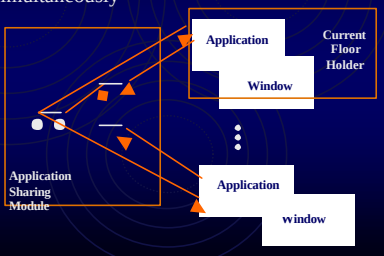


Distributed Model



Distributed Application Sharing

- Copies of the application execute on multiple machines simultaneously



Interaction Requirements

- Interaction with the system has to be designed at four levels
  - Coordination of interactions between individuals mediated by the system
  - Coordination of interactions between individual users and the system itself
  - Coordination of user interactions with shared artifacts
  - Coordination of communications between system components independent of or implicitly initiated by users

Augmentation and Agents

- Augmentation and agents are two points on a continuum of shared control of the activity
- The goal of either approach is:
  - Reduction of cognitive overhead
    - What are the tasks a human must attend to
    - What might the system know
  - Task efficiency
    - I'll do that for you
    - Here's a button
- The key is developing the appropriate level and target
  - autonomous versus approved actions
  - simple versus complex versus communal tasks

"Information"

- Use of information streams
  - Keeping track of progress
    - What could the system tell us
  - Finding a meeting time
    - What can be infer from behavior
    - Collaborator awareness

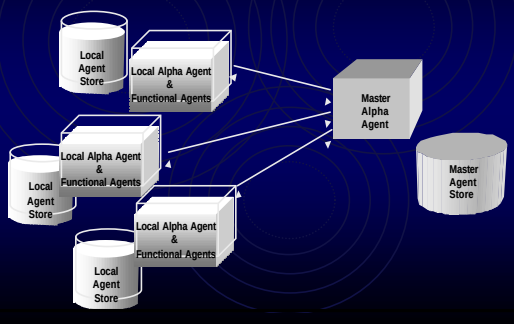
Visualization

- Visualization of information
  - colors, textures, shapes, etc
  - attention to preattentiveness
  - overloading of attributes
  - type and discrimination of attibute
    - color versus saturation (200 versus 10)
    - size versus color (interval versus nominal)
- Visualization of relationships
  - directed acyclic graphs
  - webs
  - tables
  - hierarchies

Agent Functionality

- Persistent memory
  - agents may have both individual and social memory which may be rote, organized, or self organizing
- Embedded logic
  - the embedded logic may be simple if then, structured based on knowledge and information streams and self modulating
- Message passing capability
  - message passing may be hierarchically structured or direct
- An appropriate interaction style or persona
- A lifespan
  - Agents come into being in accord with their function(in response to user or agent requests, as a result of system or process start up, or on a preplanned schedule.
  - Agents terminate when the task is done or the session ends

An Agent Architecture



Agent Types

- Executive agents are responsible for planning level skills involving the entire group, or subgroups.
- Collaborative agents are responsible for actions involving more than one individual.
- Contributory agents are responsible action involving only a single individual.
- Communications agents are responsible for managing communications between individuals.
- Service agents are responsible for low level services to individuals or system components. The tasks are simple and implicitly understood.

Agent Personas

- Executive: user must trust that the direction provided is correct before starting use.
- Collaborative: trust develops based on results of efforts -- must be trusted by all involved.
- Contributory: Trust based on the results of the efforts for one particular individual.
- Communications: Must be seen as representing the wishes of the initiator without bias.
- Service: The agent begins with implicit trust and loses that trust only when performance shows significant failures.

Some Examples of Agents

- Provide social awareness information
  - activity
  - availability
  - commitment
  - disposition
- Conduct an analysis of the information store to highlight areas of interest
- Observe an author and a document and provide editorial advise
- Manage appointments and meetings
  - patterns of groups interaction
- Run group meetings controlling discussions

CASCADE: Motivation and Focus

In situations in which groups of people collaborate, it is often the case that documents are critical to the collaboration, either as the goal of collaboration or as the main shared information space on which the collaboration is based. Increasingly, these documents exist in highly structured electronic form and are distributed. The goal of this research effort is to develop a test bed in which we can explore the impact of various kinds of user agents on the collaborators, the collaboration process, and the products of the collaboration.

CASCADE: Goals

- Operationally, CASCADE is designed to aid the document development process by:
  - Reducing cognitive overhead in tasks
  - Reducing the complexity of structured document management by using a DBMS repository
  - Increasing efficiency via task - and document-aware network protocols.
- Academically, CASCADE provides a test bed for assessing the impact of a set of tools on individual and group intellectual activity related to group documents authored in a network environment.

Structural Architecture

- Three tier client server
- RPC>>DAS>>CORBA protocols
- DBMS modeled documents
- SGML/Hytime compliant display/editor with CORBA or plug-in substitution allowed. (Blind spot dilemma)
- Client will serve as a mime-like platform
  - Access to public and private documents
  - Interfaces to mail, conferencing, and other utilities

Functional Architecture

- Navigation modules
  - Space, browser, and intra node navigation
- Document access and control modules
  - DTD to instance modules
  - Viewing, commenting, and editing modules
  - Group, node, and project construction and modification
- Information and communications modules
  - Document, group, and project activity
- Agent modules
  - Awareness agents
  - Conferencing agents
  - Summary agents
  - Balloting

CASCADE: Documents

SGML/Hypertext provide new opportunities

- Modularized text fragments (elements or nodes).
- Typed links between anchors of all types.
- Element Attributes -- metadata.
- Structural editing
- Component extraction
- Link and componenet Management
- Document versioning and locking
- Tools for navigating documents
- Tools to manipulate document parts -- e.g. aggregation of comments

CASCADE: Comment Management

- Provide facilities to type questions and comments
  - What is the nature of the question or comment?
  - What is the status of the question or comment?
  - Who is it targeted to?
- Provide facilities for question and comment analysis
  - Where are there lots of questions?
  - Where are new comments appearing?
  - Where are the arguments -- comments on comments
  - Where are the substantive comments

CASCADE: Communications

- Use data to aid efforts of participants
  - Meetings based on historical usage patterns
  - Conferencing based on who is available
- Provide access to support information
  - Agendas, minutes, reference documents.
- Manage other interactions for the group
  - Send reminders
  - Keep track of contacts and addresses
- Manage meetings
  - Set up meetings
  - Control the pattern or structure of the interactions