A Scalable and Extensible Interactive Scenario Architecture for Distributed C2 Simulations

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Examples:

- Training
- Assessment
- Experimental studies
  - User behavior
  - Collaborative design-making
NeoCITIES

Alerts Bar
Past Alerts Button
Feedback Meter
DHS Threat Level
Resource Details
On-Map Event Icon
Mini-Map
Action Menu
Send Resources
Resources Panel

Chemical fire reported in Fenske Building... (11:15) - Park 1
View Past Alerts

Squad Car #1
2 officers
11:24 am
X-163

1 adult
Arrest
Around 11:25 am

Squad Car #2
2 officers
11:24 am
X-163

1 adult
Arrest
Around 11:25 am
Scenario Structures

- **Linear**
  - events follow a certain sequence in time *not* affected by interaction
  
  **Problems:**
  - scenario is rigid
  - assumes certain user behaviors

- **Branching**
  - the events change due to user actions
  
  **Problems:**
  - Exponential growth limits computation and design
Previous Research on scenario Architectures:

– Mateas’s work using OZ project work at CMU
– M. Young’s work on the use of plan-based architectures
Our Approach

- **Scenario Architecture**
  - Scenario authoring split into several layers
  - Scenario representation
  Contribution: easily maintainable, extensible, scalable, scenarios made up of reusable units

- **Several novel techniques**
  - Dynamic interactive Scenario
  - Responsive agent systems
  - Use of User modeling to adapt scenarios
  Contribution: enhances adaptability, realism, and overall experience
Dynamic Scenario Architecture

- User Model
- Scenario Generation Engine
- Scenario Manager
- Simulation Engine

Connections:
- User Model to Scenario Generation Engine
- Scenario Generation Engine to Scenario Manager
- Scenario Manager to Simulation Engine

Connections with labels:
- "Scenario Event" from Scenario Generation Engine to Scenario Manager
- "Events and Actions" from Scenario Generation Engine to Scenario Manager
- "Behavioral plans & Timing constraints" from Simulation Engine to Scenario Manager

Other connections:
- "Current State" from Agent Architecture to Scenario Manager
- "Characters Action" from Agent Architecture to Scenario Manager
- "Agent Architecture" to "Current State" and "Characters Action"
Scenario Representation

- Three layers of abstraction: scenes, scenario events, individual agents

- **Basic idea**: Each *scenario* has a *scenario goal* achieved by some *scenes* whose *scene goals* are achieved by some *scenario events* whose *scenario-event goals* are achieved by some *agents behaviors*
Scenario Representation

- **Scenes**: highest layer of abstraction
  - Scene goals
  - Preconditions
  - Posteffects
  - Subgoals (Scene goals | Scenario-Event goals)
- **Scenario Events**: second layer of abstraction
  - Scenario-event goals
  - Preconditions
  - Posteffects
  - Subgoals (Scenario-Event goals | Agent goals)
Dynamic Scenario Architecture

- User Model
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- Simulation Engine

- Current State
- Behavioral plans & Timing constraints
- Events and actions
- Characters Action
- Events and Actions

Agent Architecture
Scenario Engine

• Reactive planning is used to
  – select scenes
  – Then select scenario events
To solve scenario goal

• Selection Process, considers
  – User model
  – Scenario event and Scene history
  – Favors varying difficulty depending on user actions and model
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Relations:
- User Model -> Scenario Generation Engine
- Scenario Generation Engine -> Scenario Manager
- Scenario Manager -> Simulation Engine
- Simulation Engine -> Scenario Generation Engine
- Scenario Generation Engine -> Events and Actions
- Scenario Manager -> Scenario Event
- Scenario Manager -> Behavioral plans & Timing constraints
- Scenario Manager -> Events and actions

Components:
- Dynamic Scenario Architecture
- Characters
- Action
- Current State
- Behavioral plans & Timing constraints
- Events and Actions
- Events and actions
Adaptable/Responsive Agents

- Agent behavior Representation
  - Behavior goal
  - Behavior Precondition
  - Behavior Posteffects
  - Behavior Effects
  - Behavior Subgoals
- Reactive planning is used to select simple character actions given agent-behavior selected
Adaptable/Responsive Agents

- User monitoring
  - Mouse clicks
  - Object interaction
  - Abstraction of: user attentiveness

- Feedback System for behavior failure
declaring and reselection
  - Failure Condition
  - Failure Tolerance
Scenario Manager

- Hidden agent that
  - Coordinates agent behaviors
  - Synchronizes timing of agent behaviors
- Uses rules to synchronize timing
  E.g. do not start talking until character ?x finishes talking
- It coordinates behaviors by forming a unified plan of behaviors
Dynamic Scenario Architecture

- User Model
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- Scenario Manager
- Simulation Engine

- Agent Architecture
  - Current State
  - Characters Action

- Behavioral plans & Timing constraints
- Scenario Event
- Events and Actions
- Events and actions
User Modeling

- Representing user patterns of decision-making
- represented as a vector of qualities
  - e.g. <impulsive, attentive, self-interested>
- calculate vector values using rules; given
  - user actions, history of user actions, scenario state
Conclusion

- Scenario Architecture
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  - Scenario representation
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- Several novel techniques
  - Dynamic interactive Scenario
  - Responsive agent systems
  - Use of User modeling to adapt scenarios
    Contribution: enhances adaptability, realism, produces better mechanism for training and assessment.