



Goal/Task-Based User Interfaces

Intelligent User Interfaces

Professor Charles Rich
Computer Science Department
rich@wpi.edu

1. Goal/Task Based User Interfaces

- *Basic concepts:* goals/tasks, recipes, plans
- *How used:*
 - hierarchical task analysis (modeling)
 - planning
 - plan recognition

Goal/Task Based User Interfaces

- System contains and uses (partial) model of what a person is trying to accomplish and how to operate the system to contribute
- Merely “contains” not enough, e.g., a searchable user manual
- But similar knowledge *is* contained in a *good* user manual --- “active manual”
- Example of “reflection” (often considered a hallmark of intelligence)

Goal/Task Based User Interfaces

- Kinds of knowledge system needs to represent and reason about:
 - **objects** (in the computer and/or real world) and their properties/relations
 - e.g., books, authors, ISBN numbers, etc.
 - e.g., window, scroll bar, text position, etc.
 - (primitive) **actions**/events and how they affect objects
 - e.g., lookup title in catalog, take book off shelf, etc.
 - e.g., open/close window, move cursor, etc.

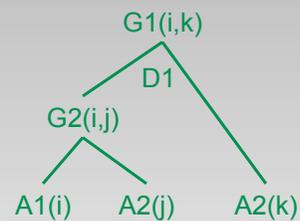
Goal/Task Based User Interfaces

- Kinds of knowledge system needs to **represent** and **reason** about: [cont'd]
 - typical user **goals**
 - e.g., borrow a library book
 - e.g., write a letter
 - steps (**decompositions**) to achieve particular goals (under particular conditions)
 - e.g., find book; take book to checkout counter
 - e.g., start editor; write text; save file

Note “task” is used generically for primitive action or goal.

Goal/Task Based User Interfaces

- Somewhat more formally...
 - **Domain Model:** $\{ \mathcal{T}, \mathcal{A}, \mathcal{R} \}$
 - \mathcal{T} object types
 - \mathcal{A} (primitive) action types
 - \mathcal{R} relations on \mathcal{T}^*
 - **Task Model:** $\{ \mathcal{G}, \mathcal{D} \}$
 - \mathcal{G} goal types (built on \mathcal{T} and \mathcal{R})
 - \mathcal{D} decomposition types (built on \mathcal{G} and \mathcal{A})
 - **A particular interaction instance:**
 - $T_1, T_2 \in \mathcal{T}$; $A_1, A_2 \in \mathcal{A}$; $G_1, G_2 \in \mathcal{G}$; $D_1 \in \mathcal{D}$
 - $i, j \in T_1$; $k \in T_2$
 - $G_1(i, k): D_1: \langle G_2(i, j): \langle A_1(i), A_1(j) \rangle, A_2(k) \rangle$



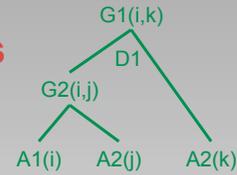
Goal/Task Based User Interfaces

- Task modeling (analysis)
 - Defining the domain and task models for a particular application
 - Somewhat of an art---we'll practice it later
 - finding right level of abstraction
 - what to ignore, what to make primitive
 - alternative groupings of lower-level actions/goals
 - “Achilles heel” of goal/task based user interfaces
 - special case of “knowledge acquisition bottleneck”
 - research towards automating using demonstration and/or learning techniques

Goal/Task Based User Interfaces

- Reasoning techniques
 - **planning**: finding a sequence of actions to achieve a desired state of the world
 - first principles
 - hierarchical task network
 - **plan recognition**: inferring plans or goals from observing actions
 - goal recognition
 - **general inference**: e.g., about domain relations
 - fast, incomplete (e.g., constraint propagation)
 - dependency-directed (e.g, TMS)

Goal/Task Based User Interfaces

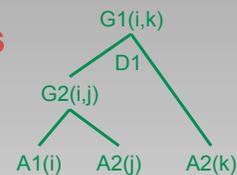


■ Planning tradeoffs

- **First principles** (“classic”)
 - requires *complete domain model*, i.e., the pre/postconditions of all actions accurately known
 - very flexible and general
 - many search algorithm variations: forward, backward, island, partial-order, hierarchical, etc.
 - task model not required, but can be used
- **Hierarchical task network**
 - only the task model (predefined goals & decompositions)
 - task types can just be names (no pre/postconditions)
 - can use more domain model information if known

Research to synthesize the two approaches.

Goal/Task Based User Interfaces



■ Plan recognition

- reduces communication burden, e.g.,
 - observe A1(i) → infer G2, G1, D1 → suggest A2(j) next*versus*
 - tell G1(i,k), tell D1, observe A1(i) → suggest A2(j) next
- goal recognition: just G1, G2 (not D1)
- both kinds of recognition NP-complete in general
- however, can often be done practically
 - incremental (in context of collaboration)
 - fall-back on communication

Goal/Task Based User Interfaces

- Interaction styles
 - pure advisor
 - user performs all actions (e.g., system does not have physical access to world)
 - system may not be able to directly observe actions (relies on user's reports)
 - system advises, critiques, etc. (fail soft)
 - purely automatic
 - system performs all actions
 - user provides toplevel goal (NB: difficulty of expression)
 - difficult to recover from undesired behavior
 - collaborative (mixed initiative)
 - best of both, but hardest to implement

Goal/Task Based User Interfaces

- *Readings:*
 - Rich & Sidner, DiamondHelp: A Generic Collaborative Task Guidance System, AI Magazine 2007
 - Lieberman & Espinosa, A Goal-Oriented Interface to Consumer Electronics using Planning and Commonsense Reasoning, IUI'06
 - ANSI/CEA-2018 Task Model Description (CE Task 1.0), 2007
[Basis for semester project!]



CEA-2018 Task Model Description



CEA-2018 Task Model Description

Half of all “malfunctioning products” returned to stores by consumers are in full working order, but customers can’t figure out how to operate the device...

-E. den Ouden, Technical University Eindhoven (Ph.D. thesis 2006)

This usability problem is particularly acute when devices are connected in home networks, because achieving a single goal often requires understanding how to operate multiple devices.



CEA-2018 Task Model Description

Produced by R7 Working Group 12 (created March, 2006)

Co-Chairs: Charles Rich, Mitsubishi Electric Research Labs
Alan Messer, Samsung Research

Editor: Gottfried Zimmerman, Consultant

CEA-2018 Task Model Description

WG12 Participants:

Motorola	JVC	HBO
NAB	TCS	4HomeMedia
LonMarks	AT&T	DirectTV
Hitachi	LOYTEC	EchoStar
Alpine	Panasonic	

CEA-2018 Task Model Description

1 SCOPE

A **task model** is a formal **description** of the activities involved in completing a task, including both activities carried out by humans and those performed by machines.

This standard defines the semantics and an **XML notation** for task models relevant to consumer electronics devices.

CEA-2018 Task Model Description

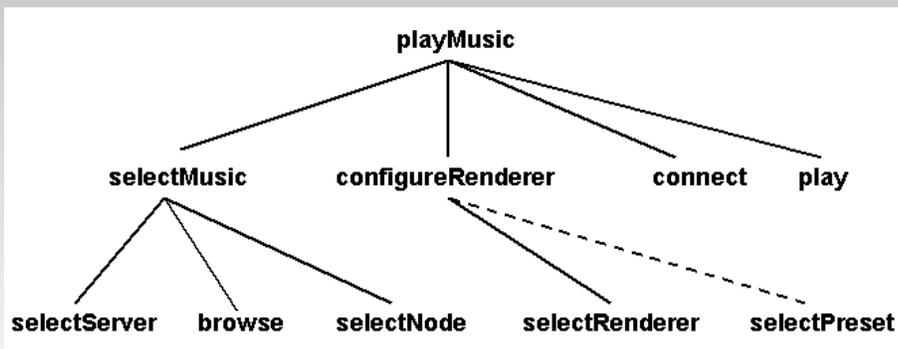
What we are not doing!

The standard does **not** define or restrict the actual appearance of a user interface or its detailed operation, and thus will not interfere with the preservation of brand identity via corporate logos or other means.

The standard does **not** depend on any specific home networking technology or infrastructure.

CEA-2018 Task Model Description

An Example Task Model



```

<taskModel
  about="http://ce.org/cea-2018/AnnexB"
  xmlns="http://ce.org/cea-2018"
  xmlns:dc="http://purl.org/dc/elements/1.1"
  xmlns:dcterms="http://purl.org/dc/terms">
  <dc:title xml:lang="en">Playing Music</dc:title>
  <dc:description xml:lang="en">CEA-2018 conformant sample task model description for
  playing music with UPnP AV devices and URC grounding.</dc:description>
  <dc:creator>Gottfried Zimmermann</dc:creator>
  <dc:contributor>Charles Rich</dc:contributor>
  <dcterms:issued>2007-08-25</dcterms:issued>
  <dcterms:modified>2007-09-10</dcterms:modified>

  <task id="playMusic">
    <subtasks id="playMusicSteps" ordered="false">
      <step name="select" task="selectMusic"/>
      <step name="configure" task="configureRenderer"/>
      <step name="connect" task="connect" requires="select configure"/>
      <step name="play" task="play" requires="connect"/>
      <binding slot="$connect.preferredConnectionProtocol" value=""/>
    </subtasks>
  </task>
  <task id="selectMusic">
    <subtasks id="selectMusicSteps">
      <step name="server" task="selectServer"/>
      <step name="browse" task="browse"/>
      <step name="node" task="selectNode"/>
      <binding slot="$browse.browseFilter" value=""/>
      <binding slot="$browse.browseSortCriteria" value="">+dc:title"/>
      <binding slot="$play.connectionId" value="$connect.newConnectionId"/>
    </subtasks>
  </task>
  <task id="configureRenderer">
    <subtasks id="configureRendererSteps">
      <step name="select" task="selectRenderer"/>
      <step name="preset" task="selectPreset" minOccurs="0" maxOccurs="1"/>
    </subtasks>
  </task>

  <script platform="URC">
    // ...
  </script>

  <script platform="URC" init="true">
    // ...
  </script>

  <task id="selectServer">
    <input name="selectedMediaServer" type="string"/>
  </task>
  <task id="browse">
    <input name="browseFilter" type="string"/>
    <input name="browseSortCriteria" type="string"/>
  </task>
  <task id="selectNode">
    <input name="selectedNodeId" type="string"/>
  </task>
  <task id="selectRenderer">
    <input name="selectedMediaRenderer" type="string"/>
  </task>
  <task id="selectPreset">
    <input name="presetName" type="string"/>
  </task>
  <task id="connect">
    <input name="preferredConnectionProtocol" type="string"/>
    <output name="newConnectionId" type="string"/>
    <output name="error" type="ErrorDescription"/>
  </task>
  <task id="play">
    <input name="connectionId" type="string"/>
    <input name="playCurrentPlayMode" type="PlayMode"/>
    <input name="playTransportPlaySpeed" type="PlaySpeed"/>
  </task>

  <!-- external events -->

  <task id="transportStatusError">
    <output name="error" type="ErrorDescription"/>
  </task>
  <task id="conNotifyContentFormatMismatch">
    <output name="error" type="ErrorDescription"/>
  </task>
  <task id="conNotifyInsufficientNetworkResources">
    <output name="error" type="ErrorDescription"/>
  </task>
  <task id="conNotifyUnreliableChannel">
    <output name="error" type="ErrorDescription"/>
  </task>
  <task id="conNotifyUnknownConnectionError">
    <output name="error" type="ErrorDescription"/>
  </task>
</taskModel>

```

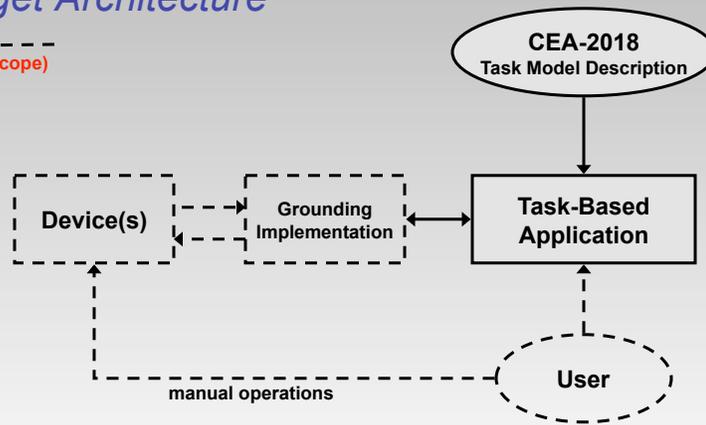
CS 525U (S 09)

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CEA-2018 Task Model Description

Target Architecture

(out of scope)



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CEA-2018 Task Model Description

Examples of Task-Based Applications

CEA-2018 will facilitate CE manufacturers developing a wide range of new capabilities to improve usability and customer satisfaction, such as:

- Network Command Menu
- Natural Language Access to EPG *
- Intelligent Help Agent *
- Task Personalization
- Intelligent Home Network Troubleshooting
- etc. * Based on submissions to DLNA call for Far-Future Usage Scenarios

CEA-2018 Task Model Description

(1) Network Command Menu



CEA-2018 Task Model Description

(2) Natural language access to Electronic Program Guide



(3) Intelligent Help Agent

What do you want to do?

Copy a videotape to a DVD.

First, insert a blank DVD in the DVD recorder.

Ok, what next?

Push the button marked "Input 1" on the DVD recorder.

... etc.



VCR CS 525U (S 09)



DVD recorder 26

CEA-2018 Task Model Description

(4) Personalized Tasks

Task: "Wake me up"

6:00 am – set thermostat to 70 F.

6:45 am – start coffee pot

7:00 am – ring alarm clock

"Wake me up tomorrow morning."

Task Modeling Exercise
