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Modeling the monitoring and adaptation of context-sensitive systems

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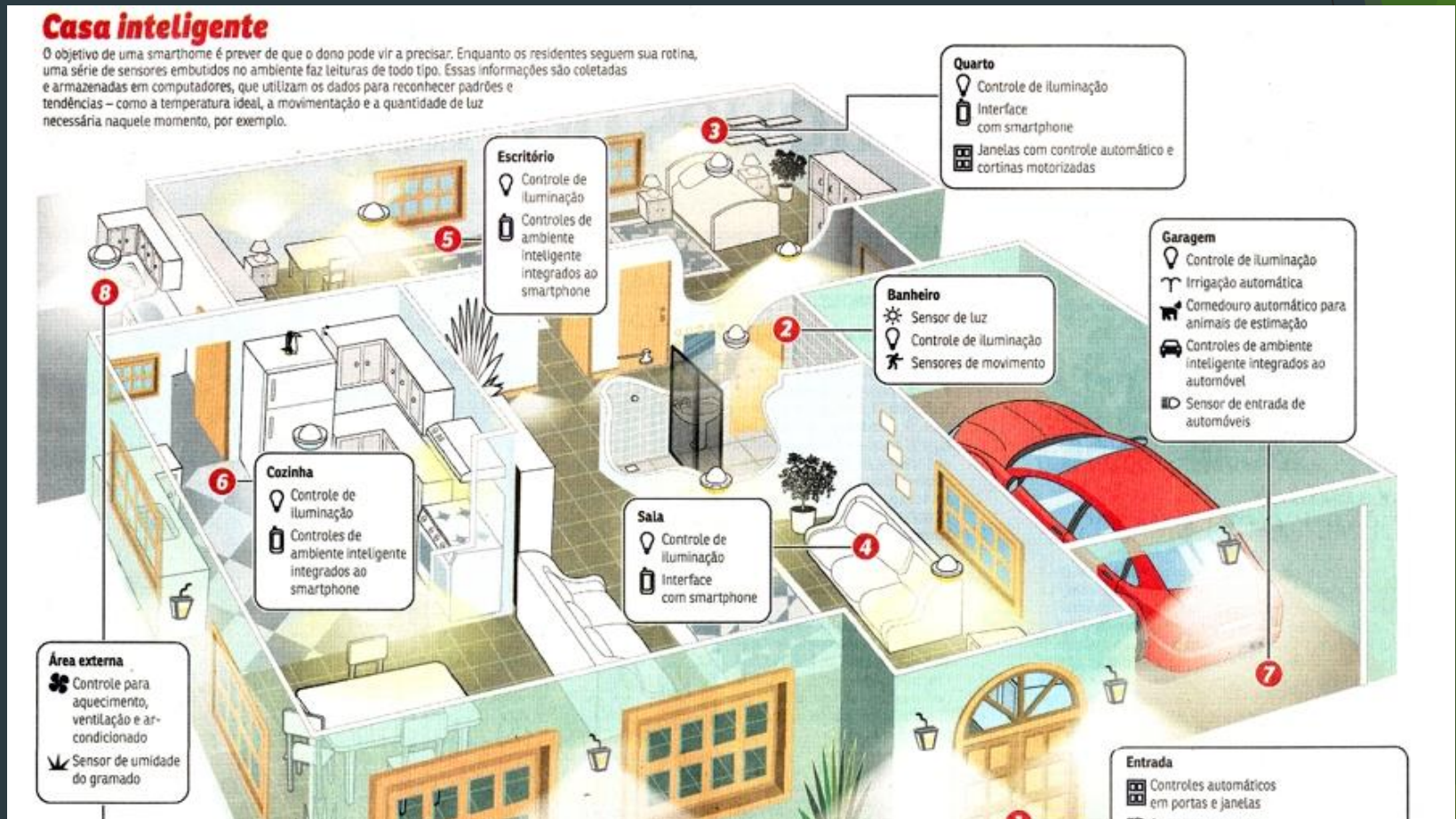
Agenda

- Motivation
  - Context-Sensitive-Systems
  - Related works
- Objectives
- GO2S (Goals to Statecharts) Process
- Evaluation
- Future Work

Motivation: Context-Sensitive Systems (CSS)

- Applications that use context to provide services and relevant information.
- GORE Definition [3]
  - "Context is a partial state of the world that is relevant to an actor's goals."



Motivation: Context-Sensitive Systems (CSS)

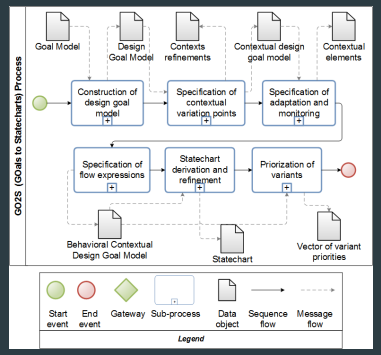
- CSS must have the following characteristics:
  - Monitoring
  - Awareness
  - Adaptability
- CSS need to be flexible, able to act autonomously on behalf of users **(adaptation)** and dynamically adapt their behavior.

Motivation: Related iStar papers

- The integration between goal modeling and context has been the topic of various researches in recent years.
  - Welsh & Sawyer (iStar10) investigated the use of i* models for the derivation of adaptive behavior of Dynamically Adaptive Systems - DAS [7]
  - Lapouchinian & Mylopoulos (iStar 11) prosed the use of Context annotations to represent and analyze variations in i* models resulting from domain variability [10]
  - Pimentel et all (iStar13) supports the design and runtime execution of adaptive software systems [8]

Objective

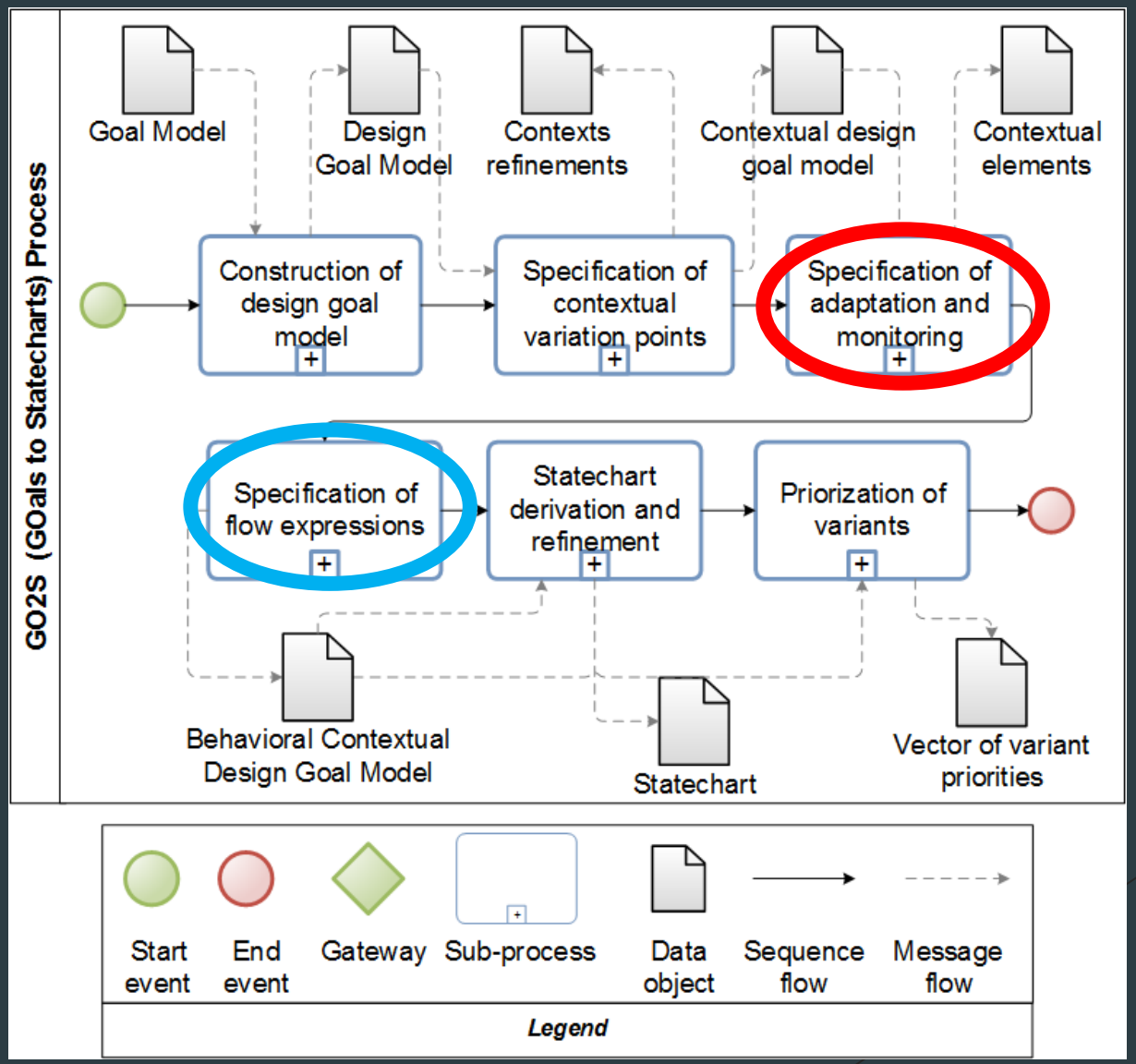
- Outline the GO2S (Goals to Statecharts) Process



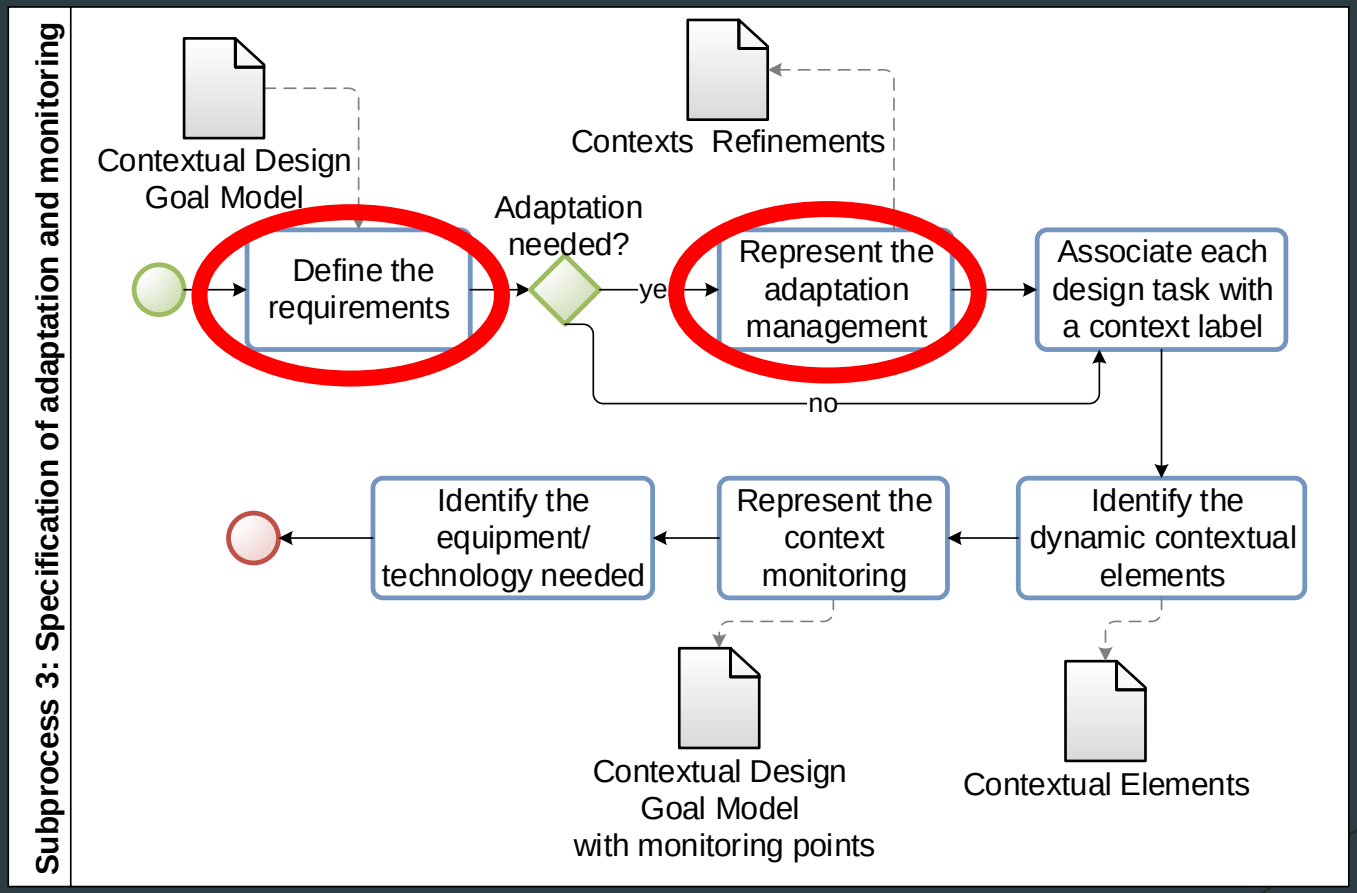
- Focus on two critical sub-processes :
  - Modeling of adaptation and monitoring (sub-process 3)
  - Specification of flow expressions (sub-process 4).

- Relies on the Contextual Design Goal Model (contextual DGM).
  - A refinement of a Design Goal Model [2], which is extended with contextual annotations [3]

GO2S (Goals to Statecharts) Process



ST3: Specification of adaptation and monitoring



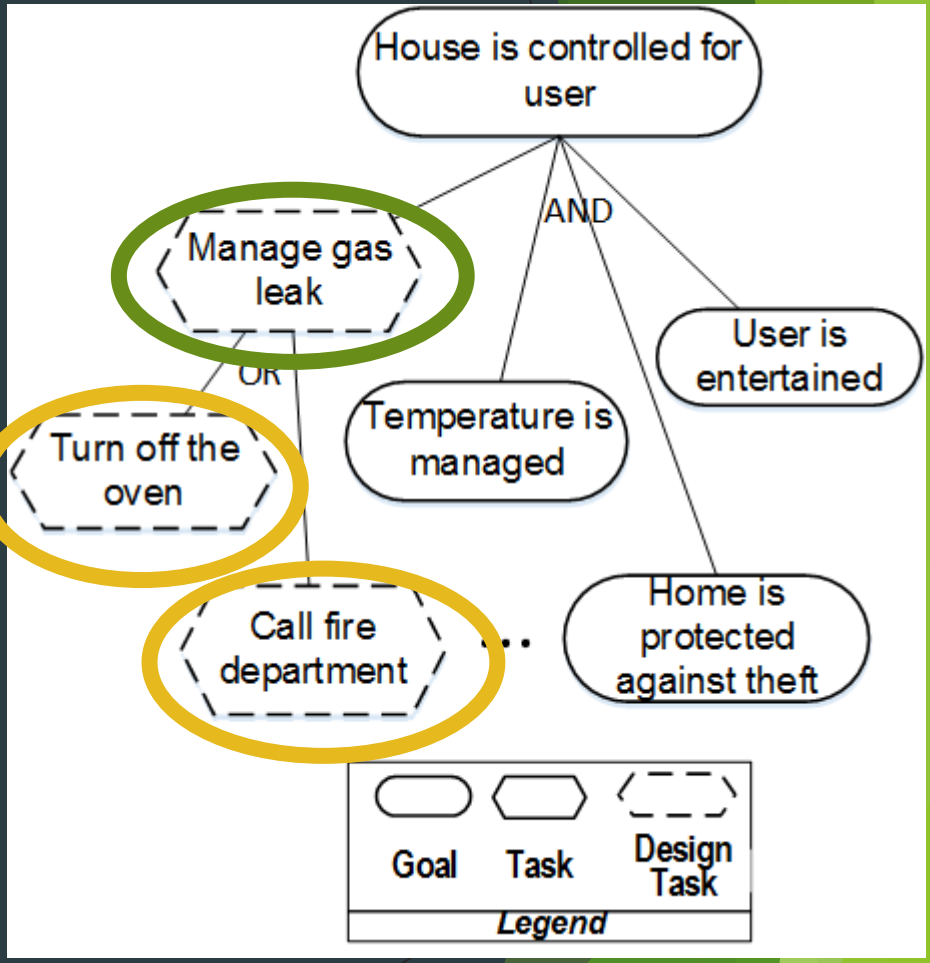
Specification of monitoring and adaptation sub-process.

ST3: Specification of adaptation and monitoring

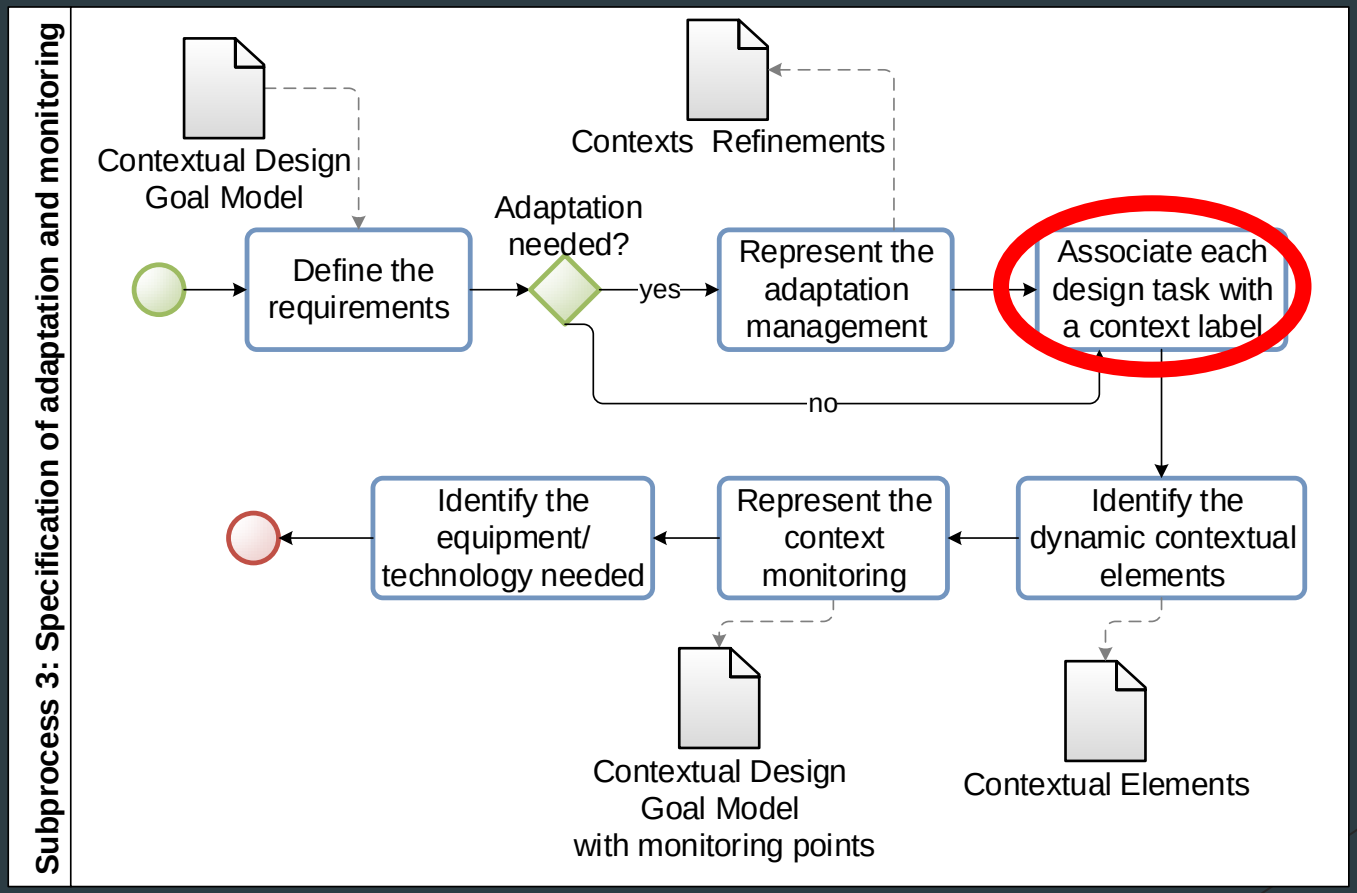
1. Add a new design task in the root node for adaptation management (This activity is necessary when the system requires more than one adaptation).

2. Add design tasks in the parent node previously created for the management of each requirement that must be monitored and adapted.

3. Add design tasks to represent the adaptation strategies for each monitored requirement.



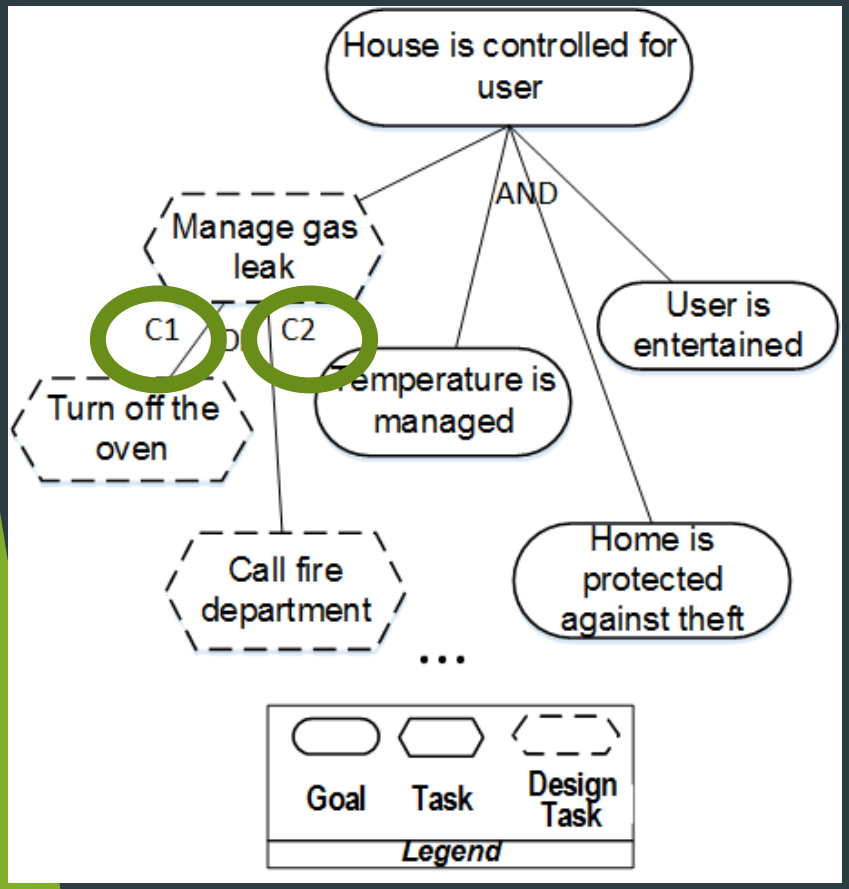
ST3: Specification of adaptation and monitoring

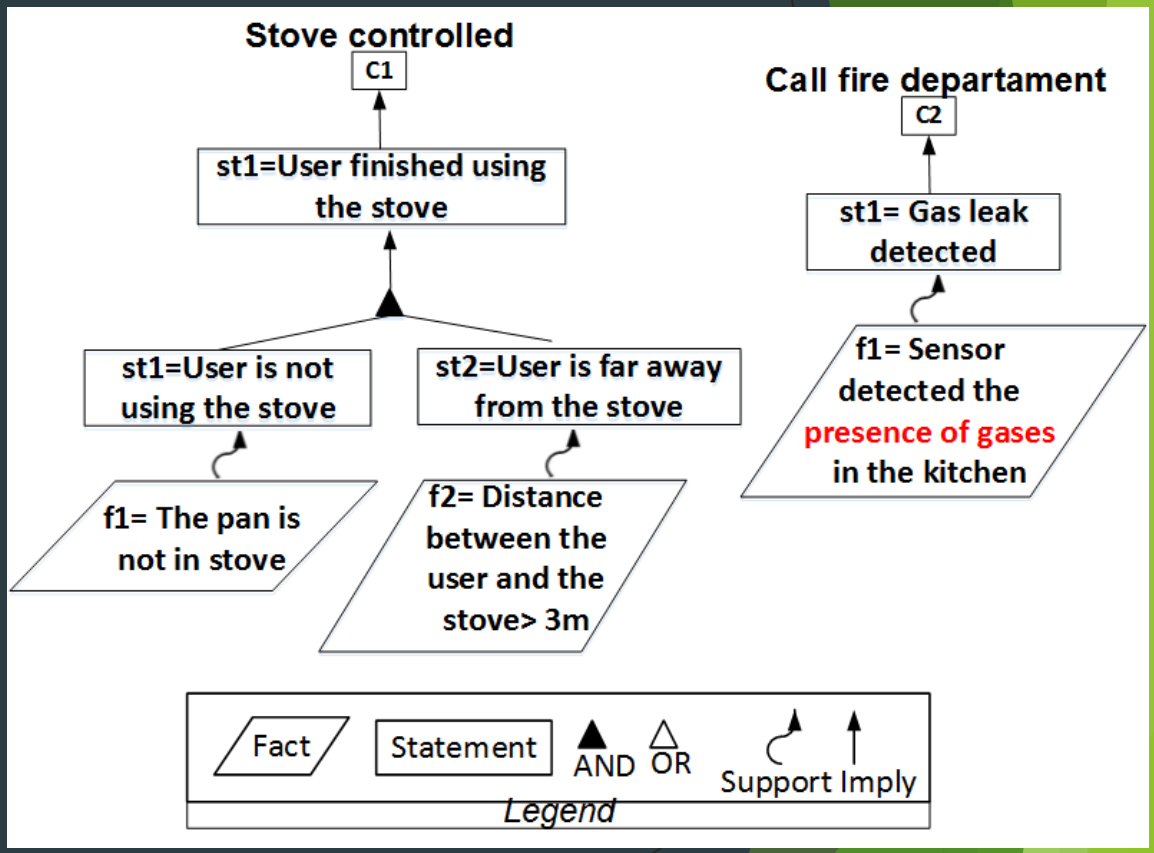


Specification of monitoring and adaptation sub-process.

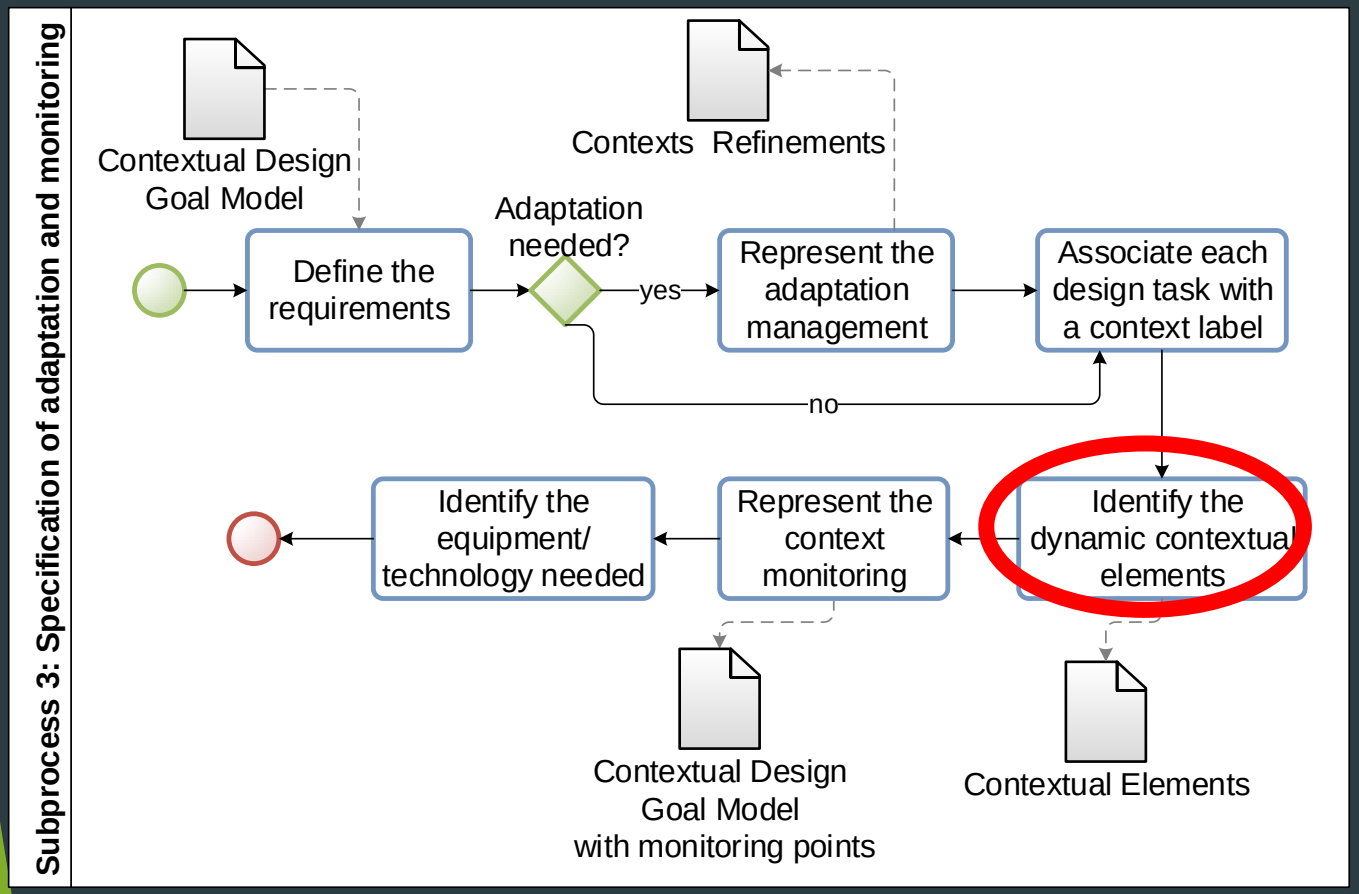
ST3: Specification of adaptation and monitoring

Associate each design task with a context label





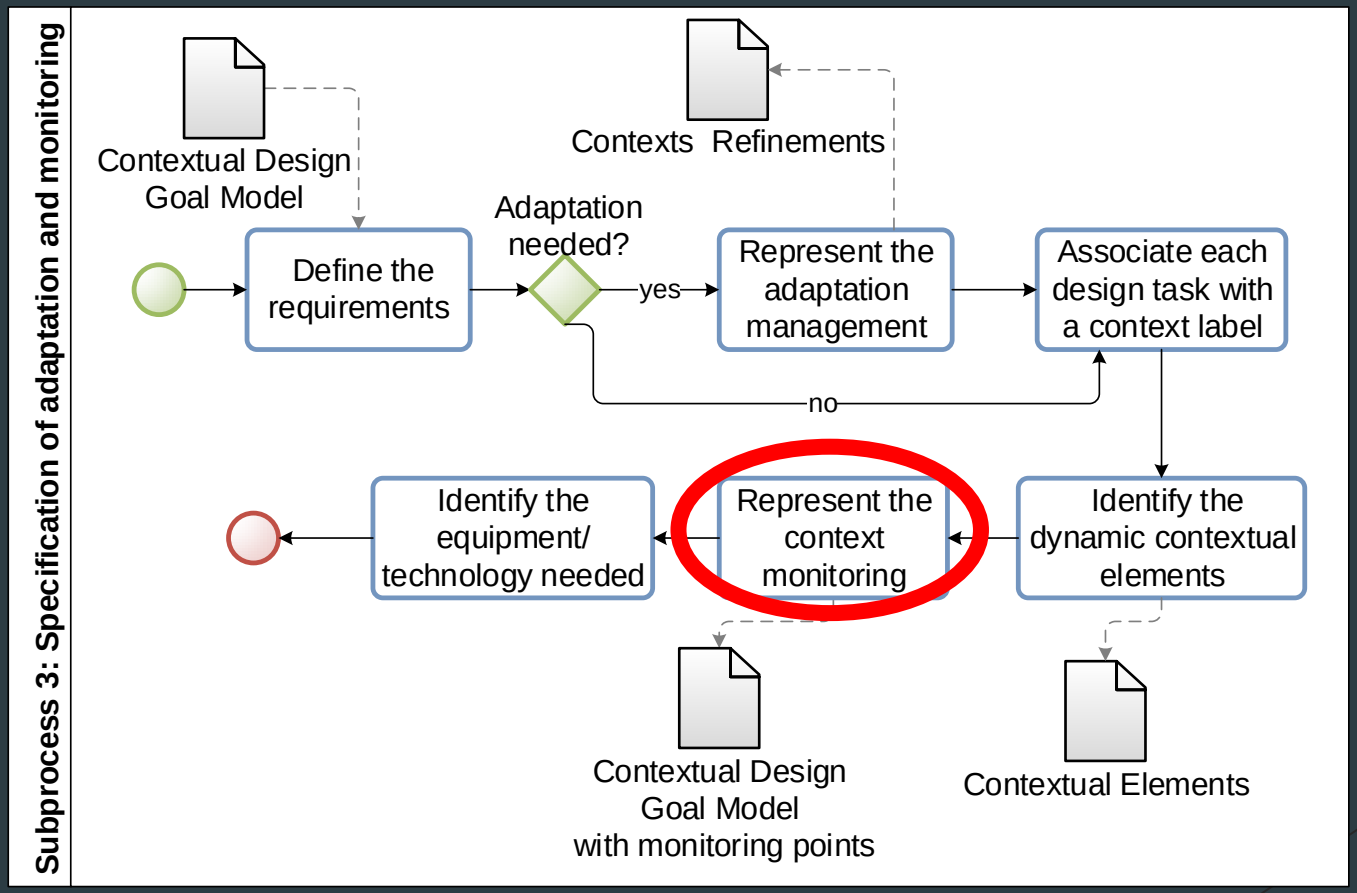
ST3: Specification of adaptation and monitoring



- Time
- Rooms
- Temperature
- Presence of gases
- Use of the stove
- Visits for the patient.

Specification of monitoring and adaptation sub-process.

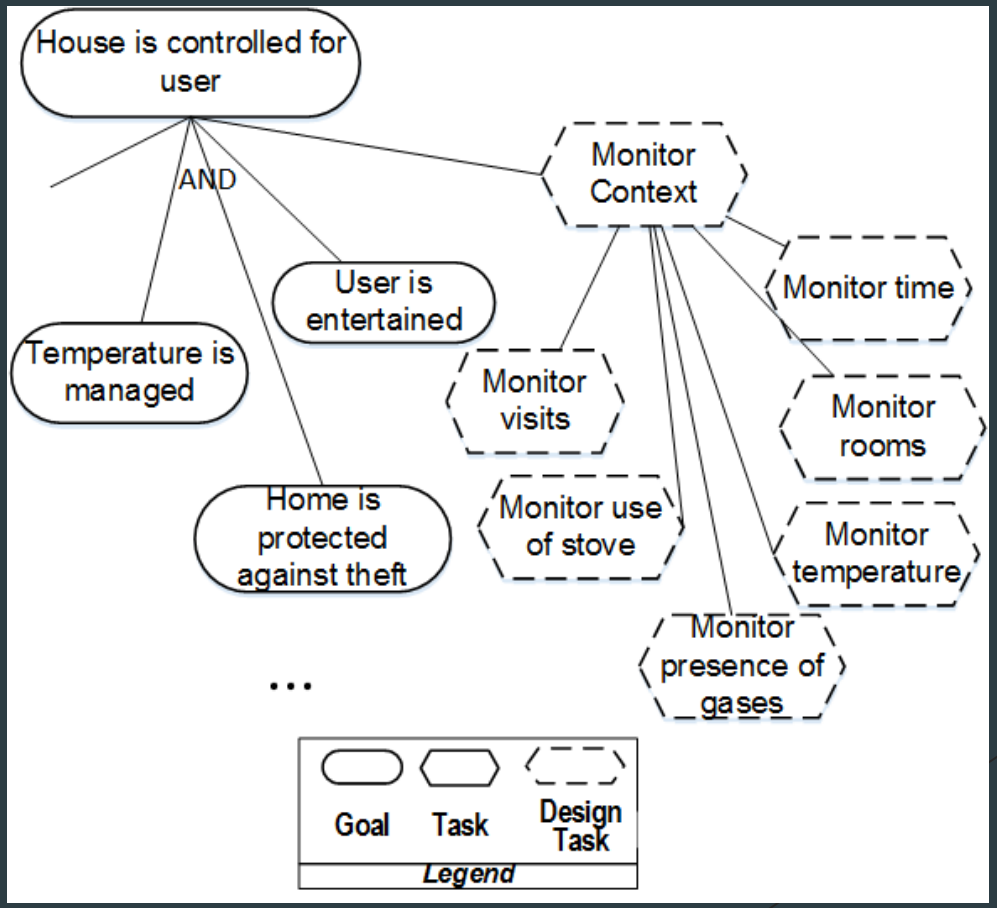
ST3: Specification of adaptation and monitoring



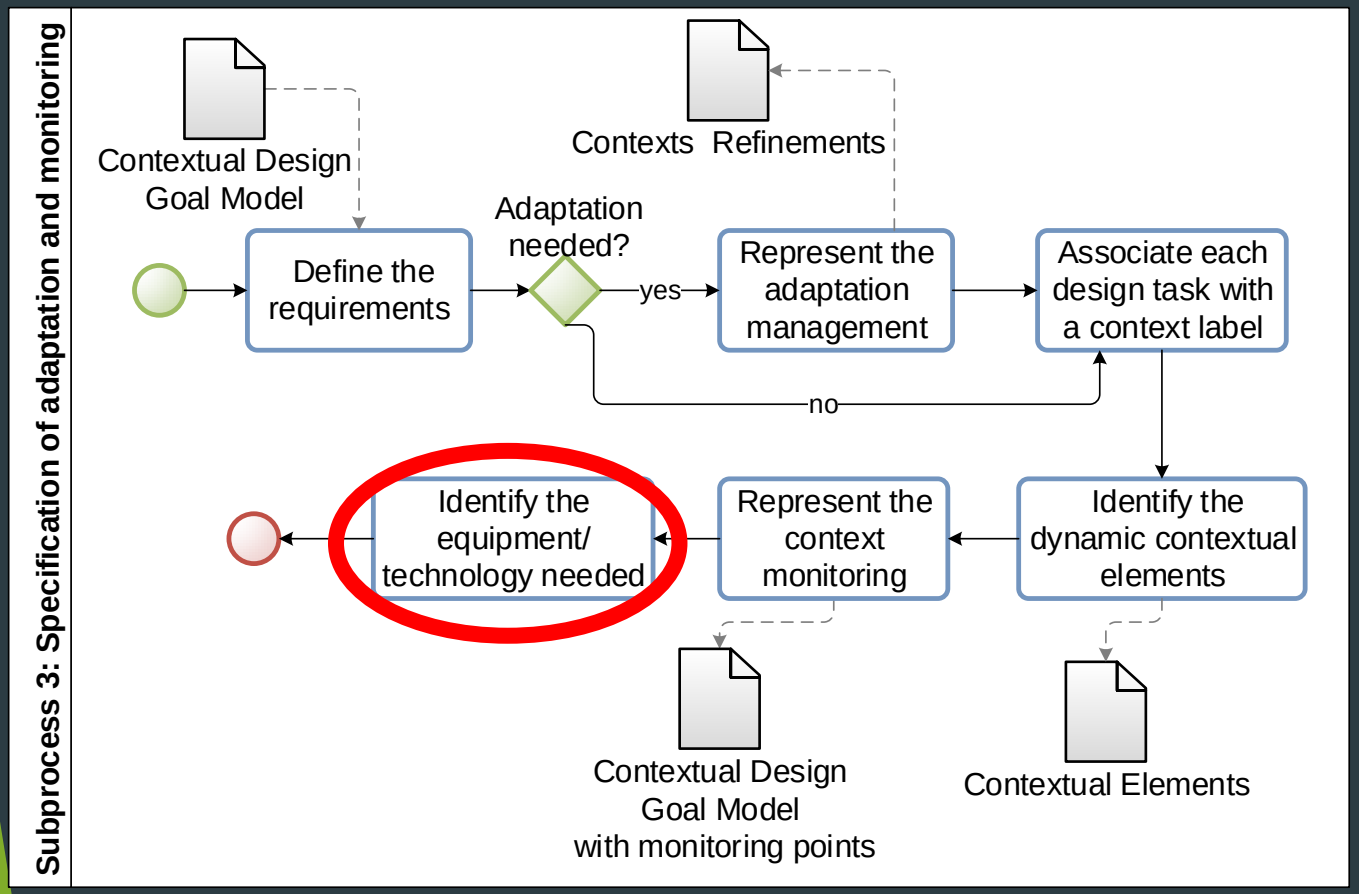
Specification of monitoring and adaptation sub-process.

ST3: Specification of adaptation and monitoring

- Represent the context monitoring



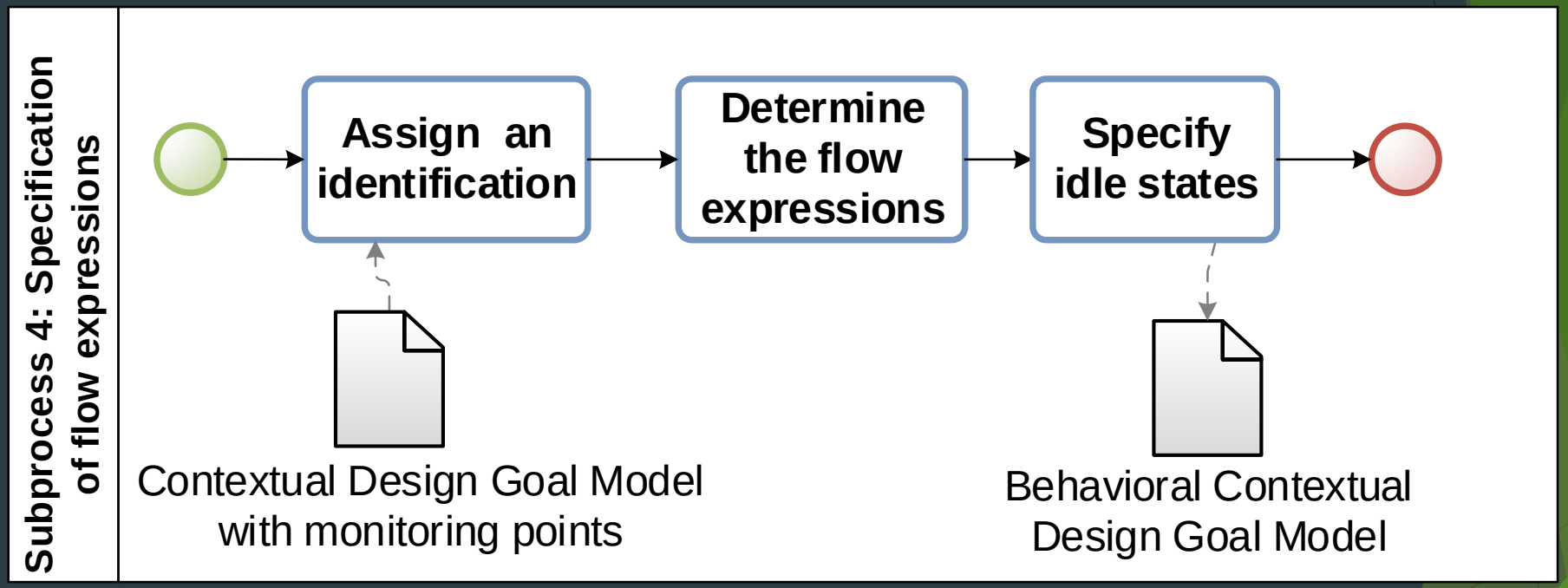
ST3: Specification of adaptation and monitoring



- Mechanisms for information storage
- Different types of sensors (presence, temperature, gas leak, stove and luminosity sensors)

Specification of monitoring and adaptation sub-process.

ST4: Statechart Derivation and Refinement



Specification of flow expressions sub-process.

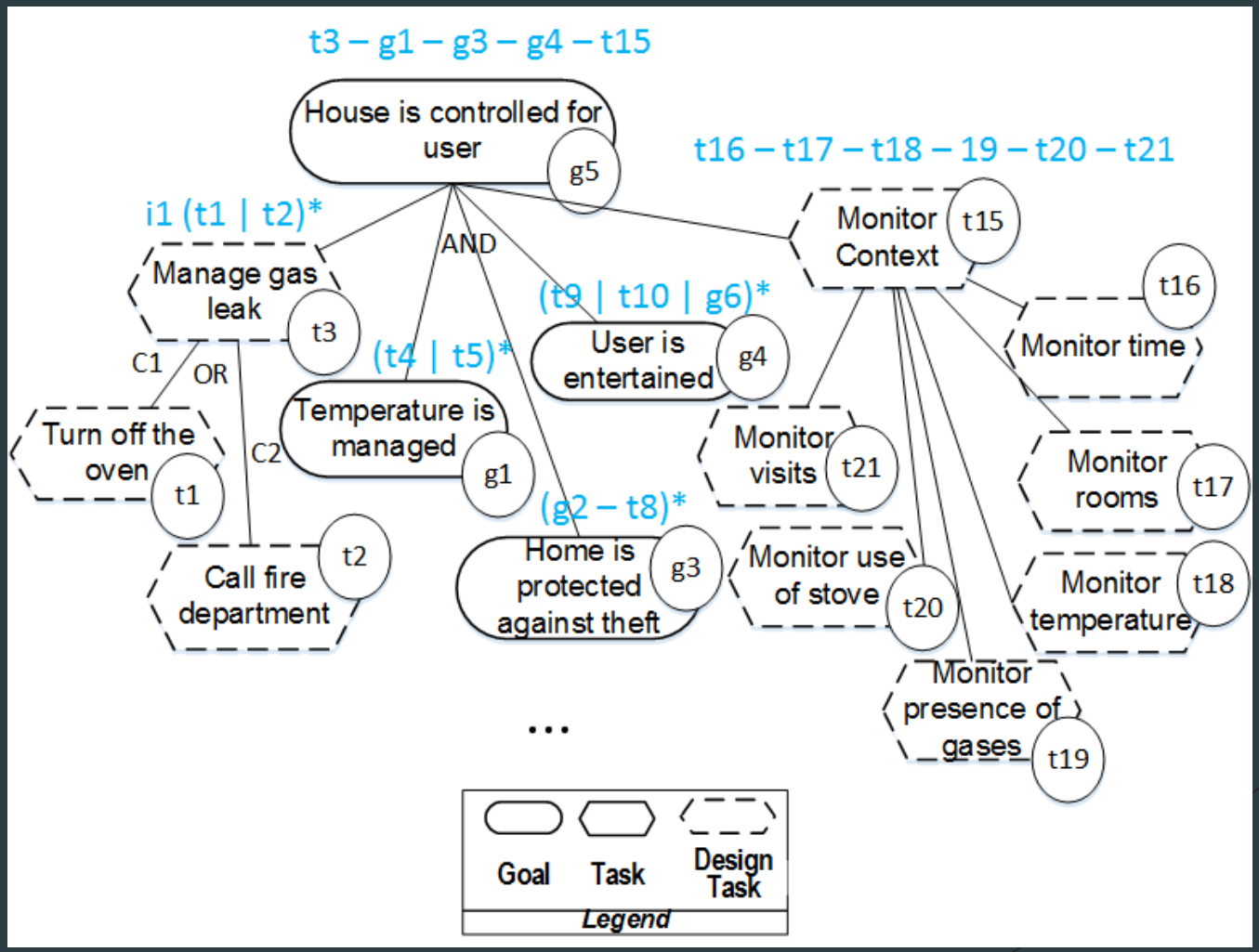
ST4: Statechart Derivation and Refinement

Flow Expressions

Table 1 Symbols of flow expressions

Expression	Meaning	Example
blank space	Sequence	(t1 t2), first t1 and then t2
—	Alternative	(t1—t2), t1 xor t2
?	Optional	(t1 t2? t3), first t1 and then t3, or first t1 followed by t2 and t
*	Zero or more times	(t1 t2* t3), first t1, then t2 zero or more times, then t3
+	One or more times	(t1 t2+), first t1, then t2 one or more times
-	Parallelism	t1-t2, t1 is executed at the same time as t2.

Modeling the behavior of context-sensitive systems



Evaluation

- We conducted a controlled experiment in order to evaluate our process.
  - This study was performed using 18 undergraduate and graduate students enrolled in a requirements engineering course divided into two groups with nine subjects each.
  - Each subject of the first group constructed a statechart of the smart home system following the GO2S process (the experimental group) and each subject of the second group created a statechart without any specific guidance (the control group).
- The experimental results are encouraging:
  - the **structural complexity** of the experimental group was **lower**
  - the mean of **behavioral similarity** was **higher** than control group
  - the subjects agreed that the GO2S process is **easy to use** [12].

Future Work

- Reasoning of context-sensitive systems (statecharts).
  - empirical benefits of ontologies for requirements engineering identified in a previous systematic literature review [9].
- Develop a case tool to implement the process.
- The other architectural views can be incorporated in our process in order to obtain a complete architecture specification.

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