1 Naming Conventions

1.1 Variable Naming Conventions

- Component names should be capitalised e.g OVEN
- The first letter of a behavior should be captialised e.g Open
- The first letter of an attribute should be lowercase e.g. timer

Variable	**Description**
N, N_i	Behavior Tree Nodes
T, T_i	Behavior Trees
C, C_i	Components
$C\#$	A Component Instance
s	A State of a Component
e	An Event
a	An Attribute of a Component
b	A Branching Condition of a Component

Table 1: Variable Naming Conventions

1.2 Node Naming Conventions

Label	Name	Description
A	Component Name	Specifies a component
B	Behavior	Specifies the behavior associated with the component
C	Operator	Describes threaded behavior that is linked to the matching node in the tree
D	Label	An optional label for disambiguation (in case a node appears elsewhere with the same component and behavior)
E	Behavior Type	Delimiters on the behavior indicating the type of behavior involved
F	Traceability Link	A reference to the requirements document
G	Traceability Status	Indicates how the node relates to the traceability link
H	Tag	The box on the left-hand side of the node (may be omitted in different contexts)
I	Behavior Tree Node	A node consisting of all or some of the information above

Table 2: Elements of a Behavior Tree Node

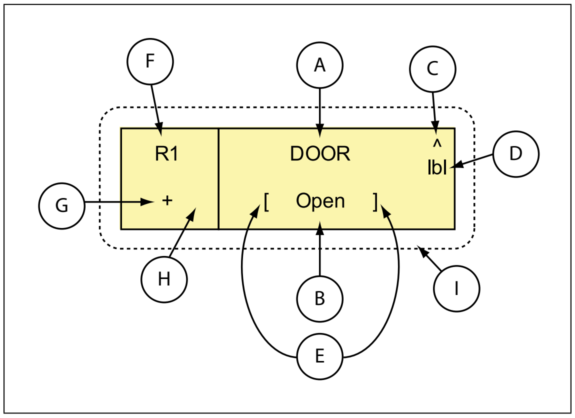


Figure 1: Behavior Tree Node Naming Conventions

1.3 Relation Naming Conventions

Label	Name	Description
A	Primary Component & Behavior	The component and behavior that form the relation
B	Related Component	Component (and optional behavior) related to the primary component and behavior
C	Qualifier	Specifies the type of the relation. Must be one of What, Where, When, Why, Who or How
D	Preposition	Further qualifies the relation to remove potential ambiguity
E	Secondary Relation	The related component is linked to the primary component using a forward slash (/). Multi-level relations can be formed by using multiple forward slashes

Table 3: Elements of a Behavior Tree Relation

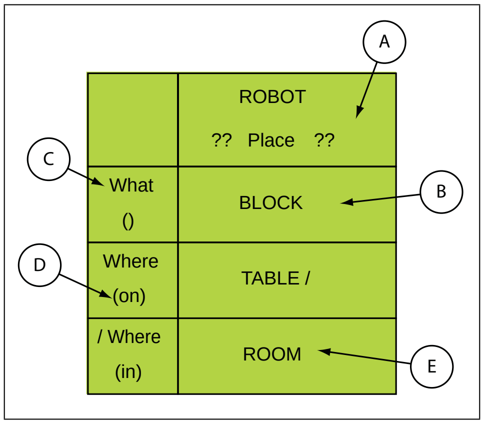


Figure 2: Behavior Tree Relation Naming Conventions

1.4 Tree Naming Conventions

Label	**Name**	**Description**
A	Ancestor Node	Any node which appears in a direct line between the node of interest and the root node of the tree
B	Parent Node	An immediate ancestor
C	Sibling Node	A node which shares the same parent
D	Sibling Branch	A subtree with a sibling node as its root
E	Child Node	A node immediately below the node of interest
F	Descendant	Any node appearing below the node of interest

Table 4: Nodes of a Behavior Tree

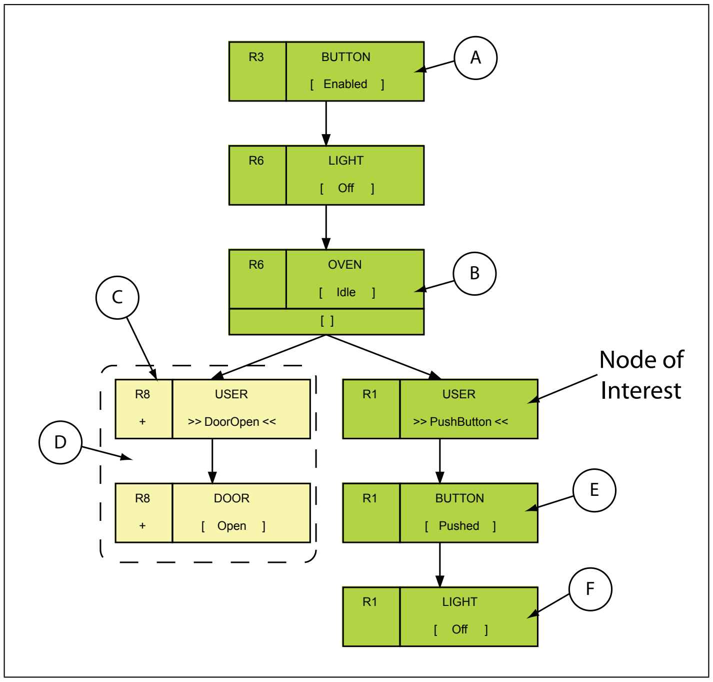


Figure 3: Behavior Tree Tree Naming Conventions

1.5 Tree Branch Naming Convention

Label	Name	Description
A	Root Node	The first node in a tree (does not have a parent)
B	Edge	A connection between two nodes
C	Leaf Node	A node with no children
D	Branch	A subtree of the node of interest

Table 5: Branches of a Behavior Tree

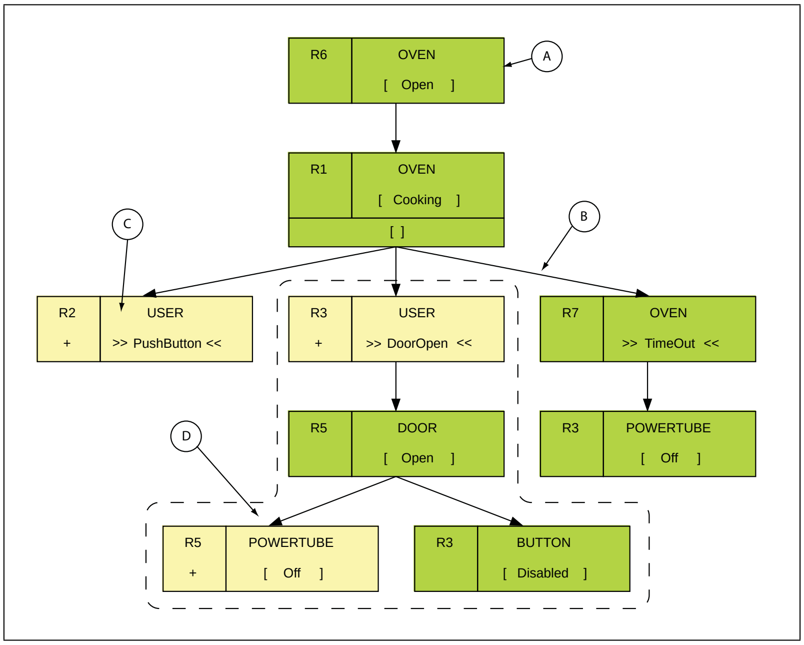
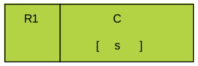
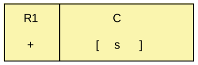
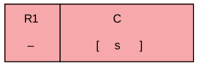
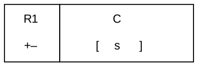
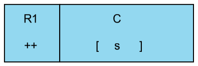
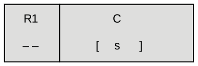


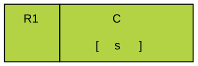
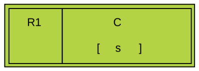
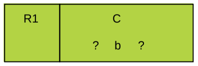
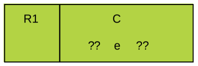
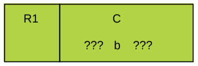
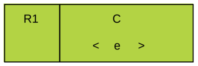
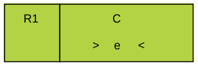
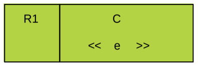
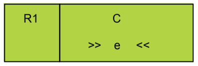
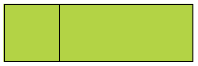
Figure 4: Tree Branch Naming Convention

2 Behavior Tree Notation & Syntax

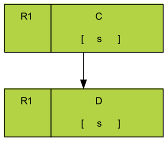
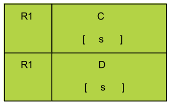
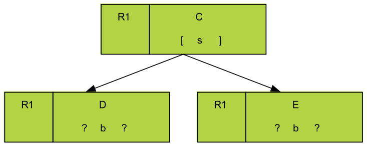
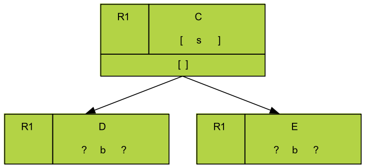
2.1 Node Tags

Type	Graphical Notation	Description
Original		No traceability status indicates that the behavior is stated in the original requirements. The color "green" is used for original requirements.
Implied		The "+" traceability status indicates that the behavior is not explicitly stated in the original requirements but is implied by the requirement. The color "yellow" is used for implied behavior.
Missing		The "-" traceability status indicates that the behavior is missing from the original requirements and is needed for completeness. The color "red" is used for missing behavior.
Design		The "+-" traceability status indicates that the behavior is a refinement of the original requirements, indicating that the behavior is implied but the detail to describe it is missing.
Updated		The "++' traceability status indicates that the behavior has been added in the post-development or maintainence phase. The color "blue" is used for updated behavior. Where there are different series of changes / upgrades we use ++v1.0, ++v2.0, etc to indicate the particular upgrade series.
Deleted		The "–" traceability status indicates that the behavior has been deleted from the behavior tree. The color "grey" is used for deleted behavior, but the nodes may also be hidden optionally by using tool support.

2.2 Basic Nodes

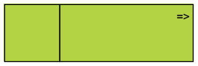
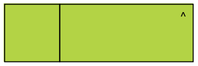
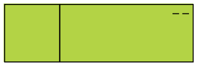
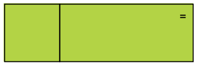
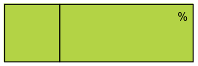
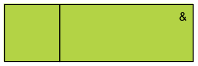
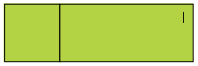
Type	Graphical Notation	Description
State Realisation		Component C realises state s.
System State Realisation		This is a state realisation decorated with a double box to indicate the component is a system component in the current context. There can only be one system component in each context.
Selection		If condition *b* evaluates to true, then pass control to child nodes otherwise terminate.
Event		Wait until event *e* is received.
Guard		Wait until condition *b* evaluates to true, then pass control to child nodes.
Internal Output		Generate input *e* and send to the system.
Internal Input		Wait for input *e* from the system.
External Output		Generate output *e* and send to the environment.
External Input		Wait for input *e* to be received from the environment.
Empty Node		Empty Nodes can be used together with labels to be origins or destinations of node operators. Empty Nodes are also useful for grouping child nodes into multiple branch types.

2.3 Behavior Tree Composition

Type	Graphical Notation	Description
Sequential Composition		Execute N, passing control to tree T. The behavior of concurrent BTs may be interleaved between N and T.
Atomic Composition		Execute N_1 immediately followed by N_2, passing control to tree T. The behavior of concurrent BTs may not be interleaved between N_1 and N_2.
Parallel Branching		Execute N, passing control to both T_1 and T_2.
Alternative Branching	 R1 C [s] [ ] R1 D ? b ? R1 E ? b ?	A nondeterministic choice is made between T_1 and T_2, depending on which is ready to execute (not blocked)

2.4 Node Operators

- Operators on source nodes match against the Component, Behavior, Behavior Type and Label (if present) of the destination node.
- An operator may be prefixed by a label and a fullstop to refer to a destination node with a label e.g. *lbl.*^ indicates to revert to destination node with label *lbl*.

Type	Graphical Notation	Description
Reference		Behave as the destination node. The destination node must appear in an alternative branch to the origin.
Reversion		Behave as the destination node. The destination node must be an ancestor. All sibling behaviour is terminated.
Branch Kill		Terminate all behavior associated with destination tree.
Synchronisation		Wait for destination node (or nodes).
May		The node may execute normally, or may have no effect.
Conjunction		The operators &, | and XOR correspond to logical conjunction, disjunction and exclusive or respectively.
Disjunction		
Exclusive OR