Lift event-based control - report

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1 High-level description

Goal of this project is to create simulator an controller for multi lift system. It will be parametrized by the number of lifts and the number of floors. On each floor there are two buttons (let's call them eXternal), to call any lift for going up or down. Inside lifts there are as many buttons, as the number of floors, for choosing desired floor from inside. Controller should optimize lifts movements.

2 Automaton description

$$G = (E, S, f, \Gamma, s_0, S_M)$$

2.1 States S

$$S = [W, P, Q]$$

2.1.1 Lift states

$$W = [w_1, w_2, ..., w_i, ..., w_l]$$

where:

- l - number of lifts

$$w_i = [d_i, o_i, f_i]$$

where:

$d \in \{0, 1\}$

- -1 - down
- 0 - stop
- 1 - up

$o \in \{0, 1\}$

- 0 - closed

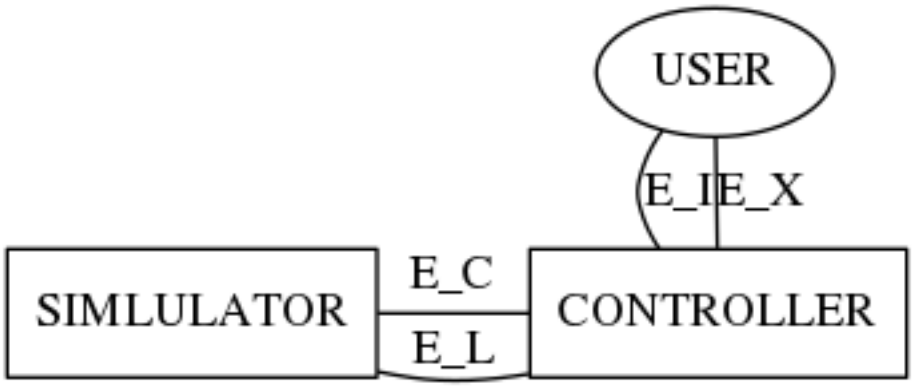

Figure 1: DES graph

- 1 - open

$f \in \{0, 1, ..., i, ..., n\}$

- i - last reached floor
- n - number of floors

2.1.2 Internal buttons states

$$P = [p_1, p_2, ..., p_i, ..., p_n]$$

where:

- n - number of floors

$$p_i = [g_{u_i}, g_{d_i}]$$

where: $g_{u_i} \in \{0, 1\}$

- 0 - not pushed
- 1 - pushed

$g_{d_i} \in \{0, 1\}$

- 0 - not pushed
- 1 - pushed

2.1.3 External buttons states

$$Q = [q_1, q_2, ..., q_i, ..., q_l]$$

where:

- l - number of lifts

$$q_i = [b_0, b_1, ..., b_i, ..., b_n]$$

$b_i \in \{0, 1\}$

- 0 - not pushed
- 1 - pushed

2.2 Events E

$$E = E^l \cup E^c \cup E^x \cup E^i$$

$$E^i = [\text{lift\_nr}, \text{button\_nr}]$$

direction $\in \{0, 1\}$

$$E^x = [\text{lift\_nr}, \text{command}]$$

command $\in \{0, 1, 2, 3, 4\}$

$$E^c = [\text{lift\_nr}, \text{ACK}]$$

ACK $\in \{0, 1, 2, 3\}$

2.3 Transition function $f(s, e)$

$0 < i < n$

$$f([0, 0, i], \text{open\_doors}) = [0, 1, i]$$

$$f([0, 1, i], \text{close\_doors}) = [0, 0, i]$$

$$f([0, 0, i], \text{move\_up}) = [0, 1, i + 1]$$

$$f([0, 0, i], \text{move\_down}) = [0, 1, i - 1]$$

2.4 Active event function $\Gamma(s)$

$0 < i < n$

$$\Gamma(0, 0, i) = \{\text{close\_doors}\}$$

$$\Gamma(0, 1, i) = \{\text{move\_up}, \text{move\_down}, \text{open\_doors}\}$$

$$\Gamma(1, 0, i) = \{stop\}$$

$$\Gamma(-1, 0, i) = \{stop\}$$

2.5 Initial state s_0

All 0.

2.6 Marked states S_M

All accepted.

3 Example

Parameters:

- number of lifts: 2,
- number of floors: 3.

$$S = [[d_0, o_0, f_0, m_0], [d_1, o_1, f_1, m_1]]$$
$$P = [[g_{u_0}, g_{d_0}], [g_{u_1}, g_{d_1}], [g_{u_2}, g_{d_2}]]$$
$$Q = [[b_{0_0}, b_{0_1}, b_{0_2}], [b_{1_0}, b_{1_1}, b_{1_2}]]$$
$$W = [S, P, Q]$$