

section *Air_impl* parents *circus_toolkit*, *basic_toolkit*

Air_IN_NO_ACTIVE_CHILD == 0
Air_IN_Off == 1
Air_IN_On == 2
Air_IN_PowerOff == 1
Air_IN_PowerOn == 2
Air_event_CLOCK == 1
Air_event_SWITCH == 0
CALL_EVENT == -1

BlockIO_Air == [*airflow* : \mathbb{N}]

D_Work_Air

is_active_c1_Air : \mathbb{N}
is_c1_Air : \mathbb{N}
is_active_FAN2 : \mathbb{N}
is_FAN2 : \mathbb{N}
is_active_SpeedValue : \mathbb{N}
is_active_FAN1 : \mathbb{N}
is_FAN1 : \mathbb{N}

ExternalInputs_Air == [*temp* : \mathbb{R} ; *inputevents* : seq \mathbb{B}]

ExternalOutputs_Air == [*airflow* : \mathbb{N}]

is_active_c1_Air : *D_Work_Air* \times \mathbb{N} \rightarrow *D_Work_Air*

$\forall b : D_Work_Air; v : \mathbb{N} \bullet is_active_c1_Air(b, v) = \langle is_active_c1_Air == v, is_c1_Air == b.is_c1_Air, is_active_FAN2 == b.is_active_FAN2, is_FAN2 == b.is_FAN2, is_active_SpeedValue == b.is_active_SpeedValue, is_active_FAN1 == b.is_active_FAN1, is_FAN1 == b.is_FAN1 \rangle$

is_c1_Air : *D_Work_Air* \times \mathbb{N} \rightarrow *D_Work_Air*

$\forall b : D_Work_Air; v : \mathbb{N} \bullet is_c1_Air(b, v) = \langle is_active_c1_Air == b.is_active_c1_Air, is_c1_Air == v, is_active_FAN2 == b.is_active_FAN2, is_FAN2 == b.is_FAN2, is_active_SpeedValue == b.is_active_SpeedValue, is_active_FAN1 == b.is_active_FAN1, is_FAN1 == b.is_FAN1 \rangle$

$is_active_FAN2 : D_Work_Air \times \mathbb{N} \rightarrow D_Work_Air$

$\forall b : D_Work_Air; v : \mathbb{N} \bullet is_active_FAN2(b, v) = \langle is_active_c1_Air == b.is_active_c1_Air, is_c1_Air == b.is_c1_Air, is_active_FAN2 == v, is_FAN2 == b.is_FAN2, is_active_SpeedValue == b.is_active_SpeedValue, is_active_FAN1 == b.is_active_FAN1, is_FAN1 == b.is_FAN1 \rangle$

$is_FAN2 : D_Work_Air \times \mathbb{N} \rightarrow D_Work_Air$

$\forall b : D_Work_Air; v : \mathbb{N} \bullet is_FAN2(b, v) = \langle is_active_c1_Air == b.is_active_c1_Air, is_c1_Air == b.is_c1_Air, is_active_FAN2 == b.is_active_FAN2, is_FAN2 == v, is_active_SpeedValue == b.is_active_SpeedValue, is_active_FAN1 == b.is_active_FAN1, is_FAN1 == b.is_FAN1 \rangle$

$is_active_SpeedValue : D_Work_Air \times \mathbb{N} \rightarrow D_Work_Air$

$\forall b : D_Work_Air; v : \mathbb{N} \bullet is_active_SpeedValue(b, v) = \langle is_active_c1_Air == b.is_active_c1_Air, is_c1_Air == b.is_c1_Air, is_active_FAN2 == b.is_active_FAN2, is_FAN2 == b.is_FAN2, is_active_SpeedValue == v, is_active_FAN1 == b.is_active_FAN1, is_FAN1 == b.is_FAN1 \rangle$

$is_active_FAN1 : D_Work_Air \times \mathbb{N} \rightarrow D_Work_Air$

$\forall b : D_Work_Air; v : \mathbb{N} \bullet is_active_FAN1(b, v) = \langle is_active_c1_Air == b.is_active_c1_Air, is_c1_Air == b.is_c1_Air, is_active_FAN2 == b.is_active_FAN2, is_FAN2 == b.is_FAN2, is_active_SpeedValue == b.is_active_SpeedValue, is_active_FAN1 == v, is_FAN1 == b.is_FAN1 \rangle$

$is_FAN1 : D_Work_Air \times \mathbb{N} \rightarrow D_Work_Air$

$\forall b : D_Work_Air; v : \mathbb{N} \bullet is_FAN1(b, v) = \langle is_active_c1_Air == b.is_active_c1_Air, is_c1_Air == b.is_c1_Air, is_active_FAN2 == b.is_active_FAN2, is_FAN2 == b.is_FAN2, is_active_SpeedValue == b.is_active_SpeedValue, is_active_FAN1 == b.is_active_FAN1, is_FAN1 == v \rangle$

$airflow : BlockIO_Air \times \mathbb{N} \rightarrow BlockIO_Air$

$\forall b : BlockIO_Air; v : \mathbb{N} \bullet airflow(b, v) = \langle airflow == v \rangle$

$temp : ExternalInputs_Air \times \mathbb{R} \rightarrow ExternalInputs_Air$

$\forall b : ExternalInputs_Air; v : \mathbb{R} \bullet temp(b, v) = \langle temp == v, inpuvents == b.inpuvents \rangle$

$inpuvents : ExternalInputs_Air \times (\text{seq } \mathbb{B}) \rightarrow ExternalInputs_Air$

$\forall b : ExternalInputs_Air; v : \text{seq } \mathbb{B} \bullet inpuvents(b, v) = \langle temp == b.temp, inpuvents == v \rangle$

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Air_state
  _sfEvent_Air_ : ℤ
  Air_B : BlockIO_Air
  Air_DWork : D_Work_Air
  Air_U : ExternalInputs_Air
  Air_Y : ExternalOutputs_Air

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channel in_FAN1 : Air_state
channel out_FAN1 : ℕ
channel input_event : (seq ℬ)
channel i_temp : ℝ
channel o_airflow : ℕ

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process Air ≐ begin

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state Air_state

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Air_FAN1 ≐

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$$\left(\begin{array}{l}
\mathbf{var} \text{ Air_B : BlockIO_Air; Air_DWork : D_Work_Air; Air_U : ExternalInputs_Air; Air_Y : ExternalOutputs_Air; _sfEvent_Air_ : } \mathbb{Z} \bullet \\
in_FAN1?s \longrightarrow \text{Air_B, Air_DWork, Air_U, Air_Y, _sfEvent_Air_ := s.Air_B, s.Air_DWork, s.Air_U, s.Air_Y, s._sfEvent_Air_;} \\
\left(\begin{array}{l}
\mathbf{if} \text{ Air_DWork.is_FAN1 = Air_IN_Off} \longrightarrow \\
\left(\begin{array}{l}
\mathbf{if} \text{ Air_U.temp} \geq 120 \longrightarrow \text{Air_DWork := is_FAN1(Air_DWork, Air_IN_On)} \\
\lceil \neg (\text{Air_U.temp} \geq 120) \longrightarrow \mathbf{Skip} \\
\mathbf{fi}
\end{array} \right) \\
\lceil \text{Air_DWork.is_FAN1 = Air_IN_On} \longrightarrow \\
\left(\begin{array}{l}
\mathbf{if} \text{ Air_U.temp} < 120 \longrightarrow \text{Air_DWork := is_FAN1(Air_DWork, Air_IN_Off)} \\
\lceil \neg (\text{Air_U.temp} < 120) \longrightarrow \mathbf{Skip} \\
\mathbf{fi}
\end{array} \right) \\
\lceil \neg (\text{Air_DWork.is_FAN1 = Air_IN_Off} \vee \text{Air_DWork.is_FAN1 = Air_IN_On}) \longrightarrow \\
\text{Air_DWork := is_FAN1(Air_DWork, Air_IN_Off)} \\
\mathbf{fi}
\end{array} \right) ; \\
out_FAN1!(\text{Air_DWork.is_FAN1}) \longrightarrow \mathbf{Skip}
\end{array} \right)$$

$Air_chartstep_c1_Air \hat{=}$

$$\left(\begin{array}{l}
 \mathbf{if} \ Air_DWork.is_active_c1_Air = 0 \longrightarrow \left(\begin{array}{l}
 Air_DWork := is_active_c1_Air(Air_DWork, 1); \\
 Air_DWork := is_c1_Air(Air_DWork, Air_IN_PowerOff); \ Air_B := airflow(Air_B, 0)
 \end{array} \right) \\
 \square \neg (Air_DWork.is_active_c1_Air = 0) \longrightarrow \\
 \left(\begin{array}{l}
 \mathbf{if} \ Air_DWork.is_c1_Air = Air_IN_PowerOff \longrightarrow \left(\begin{array}{l}
 \mathbf{if} \ _sfEvent_Air_ = Air_event_SWITCH \longrightarrow \\
 \left(\begin{array}{l}
 Air_DWork := is_c1_Air(Air_DWork, Air_IN_PowerOn); \\
 Air_DWork := is_active_FAN1(Air_DWork, 1); \\
 Air_DWork := is_FAN1(Air_DWork, Air_IN_Off); \\
 Air_DWork := is_active_FAN2(Air_DWork, 1); \\
 Air_DWork := is_FAN2(Air_DWork, Air_IN_Off); \\
 Air_DWork := is_active_SpeedValue(Air_DWork, 1)
 \end{array} \right) \\
 \square \neg (_sfEvent_Air_ = Air_event_SWITCH) \longrightarrow \mathbf{Skip} \\
 \mathbf{fi}
 \end{array} \right) \\
 \square Air_DWork.is_c1_Air = Air_IN_PowerOn \longrightarrow \\
 \left(\begin{array}{l}
 \mathbf{if} \ _sfEvent_Air_ = Air_event_SWITCH \longrightarrow \left(\begin{array}{l}
 Air_DWork := is_active_SpeedValue(Air_DWork, 0); \\
 Air_DWork := is_FAN2(Air_DWork, Air_IN_NO_ACTIVE_CHILD); \\
 Air_DWork := is_active_FAN2(Air_DWork, 0); \\
 Air_DWork := is_FAN1(Air_DWork, Air_IN_NO_ACTIVE_CHILD); \\
 Air_DWork := is_active_FAN1(Air_DWork, 0); \\
 Air_DWork := is_c1_Air(Air_DWork, Air_IN_PowerOff); \ Air_B := airflow(Air_B, 0)
 \end{array} \right) \\
 \square \neg (_sfEvent_Air_ = Air_event_SWITCH) \longrightarrow \\
 \left(\begin{array}{l}
 in_FAN1!(\theta \ Air_state) \longrightarrow \mathbf{Skip}; \\
 \left(\begin{array}{l}
 \mathbf{if} \ Air_DWork.is_FAN2 = Air_IN_Off \longrightarrow \left(\begin{array}{l}
 \mathbf{if} \ Air_U.temp \geq 150 \longrightarrow Air_DWork := is_FAN2(Air_DWork, Air_IN_On) \\
 \square \neg (Air_U.temp \geq 150) \longrightarrow \mathbf{Skip} \\
 \mathbf{fi}
 \end{array} \right) \\
 \square Air_DWork.is_FAN2 = Air_IN_On \longrightarrow \left(\begin{array}{l}
 \mathbf{if} \ Air_U.temp < 150 \longrightarrow Air_DWork := is_FAN2(Air_DWork, Air_IN_Off) \\
 \square \neg (Air_U.temp < 150) \longrightarrow \mathbf{Skip} \\
 \mathbf{fi}
 \end{array} \right) \\
 \square \neg (Air_DWork.is_FAN2 = Air_IN_Off \vee Air_DWork.is_FAN2 = Air_IN_On) \longrightarrow Air_DWork := is_FAN2(Air_DWork, Air_IN_Off) \\
 \mathbf{fi} \\
 out_FAN1?f1 \longrightarrow Air_DWork := is_FAN1(Air_DWork, f1); \\
 Air_B := airflow(Air_B, (\mathbf{if} \ Air_DWork.is_FAN1 = Air_IN_On \mathbf{then} \ 1 \ \mathbf{else} \ 0) + (\mathbf{if} \ Air_DWork.is_FAN2 = Air_IN_On \mathbf{then} \ 1 \ \mathbf{else} \ 0)) \\
 \mathbf{fi}
 \end{array} \right) \\
 \square \neg (Air_DWork.is_c1_Air = Air_IN_PowerOff \vee Air_DWork.is_c1_Air = Air_IN_PowerOn) \longrightarrow \\
 Air_DWork := is_c1_Air(Air_DWork, Air_IN_PowerOff); \ Air_B := airflow(Air_B, 0) \\
 \mathbf{fi}
 \end{array} \right) \\
 \mathbf{fi}
 \end{array} \right)
 \end{array}
 \right)$$

$$Air_output \hat{=} \left(\left(\begin{array}{l} \text{if } Air_U.inp\text{utevents}(1) = \mathbf{True} \longrightarrow \\ \quad _sfEvent_Air_ := Air_event_SWITCH ; Air_chartstep_c1_Air \\ \quad \llbracket \neg (Air_U.inp\text{utevents}(1) = \mathbf{True}) \longrightarrow \mathbf{Skip} \\ \quad \mathbf{fi} \\ \text{if } Air_U.inp\text{utevents}(2) = \mathbf{True} \longrightarrow \\ \quad _sfEvent_Air_ := Air_event_CLOCK ; Air_chartstep_c1_Air \\ \quad \llbracket \neg (Air_U.inp\text{utevents}(2) = \mathbf{True}) \longrightarrow \mathbf{Skip} \\ \quad \mathbf{fi} \\ Air_Y := Air_B \end{array} \right) ; \right)$$

$$MdlInitialize \hat{=} \left(\begin{array}{l} _sfEvent_Air_ := CALL_EVENT; \\ Air_DWork := is_active_FAN1(Air_DWork, 0); \\ Air_DWork := is_FAN1(Air_DWork, 0); \\ Air_DWork := is_active_FAN2(Air_DWork, 0); \\ Air_DWork := is_FAN2(Air_DWork, 0); \\ Air_DWork := is_active_SpeedValue(Air_DWork, 0); \\ Air_DWork := is_active_c1_Air(Air_DWork, 0); \\ Air_DWork := is_c1_Air(Air_DWork, 0); \\ Air_B := airflow(Air_B, 0) \end{array} \right)$$

$$FAN1 \hat{=} \mu X \bullet Air_FAN1$$

$$read_inputs \hat{=} \left(\begin{array}{l} input_event?es \longrightarrow Air_U := inp\text{utevents}(Air_U, es); \\ i_temp?v \longrightarrow Air_U := temp(Air_U, v) \end{array} \right)$$

$$write_outputs \hat{=} o_airflow!(Air_Y.airflow) \longrightarrow \mathbf{Skip}$$

$$ExecuteChart \hat{=} MdlInitialize ; (\mu X \bullet read_inputs ; Air_output ; write_outputs ; end_cycle \longrightarrow X)$$

$$\bullet ExecuteChart \llbracket \{ _sfEvent_Air_ , Air_U , Air_B , Air_DWork , Air_Y \} \mid \{ in_FAN1 , out_FAN1 \} \mid \{ \} \rrbracket FAN1$$

end