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Exercises for the lecture
Cyber-Physical Systems Fundamentals
Summer Term 2018

Exercise Sheet 2

(10 Points)

Lab exercises starting from Monday, 4th June 2018

The lab exercises take place at room OH16/U08. The exercise sheets will be solved during the exercise sessions.

Please simulate your StateChart before testing it on the real hardware.
Legend: 1. reset, 2. writeLine0(), 3. writeLine1(), 4. Key0Press, 5. Key1Press, 6. Key2Press

Hints:

- For this exercise sheet, we use the virtual machine **`CPSF`**.
- The archives containing the templates are available on the lab server and can be accessed via Die Archive mit den Templates befinden sich auf dem `\\pdc\cpsf`. Please note that there is a distinct template for each assignment.

2.1 Wrap Around Counter (4 Points)

Create a wrap around counter that is able to count up and down from 0 to 9. As soon as 9 (or 0, respectively) is reached, the counting should be continued at the other end of the sequence, i.e., $8, 9, 0, 1, \ldots$ and $1, 0, 9, 8, \ldots$. Moreover, the counter should have the feature to be reset to 0 by pressing a key. Please use the keys provided by the muController to control your counter.

Hints:

- To display the number, use the function writeLine0(VS_INT number).
- Since *Action Expressions* are C expressions, it is possible to use operators as, e.g., addition ($+$) or subtraction ($-$). Please note, that the modulo operator ($\%$) returns negative results when applied to negative numbers.
- By creating a *Guard Expression* for a transition, it can be ensured that it only fires when the respective event occurs and furthermore the *Guard Expression* is true. Here, C expressions can be used as well, e.g. `foo == 42`.

2.2 Fan Control (6 Points)

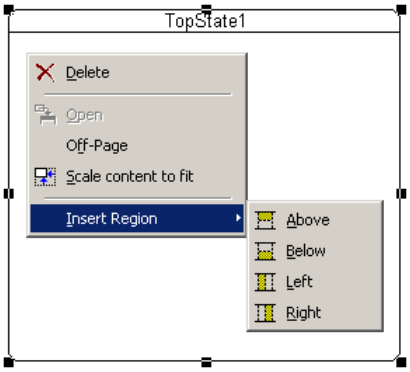
Develop a control software for a table fan. The fan has three different buttons, one for switching it on or off, one to control the speed and one to control the rotor case movement (*moving* or *not moving*). With respect to the fan speed, there are three different levels: *slow, med, fast*. If the fan speed is *fast* and the respective button is pressed again, the speed changes to *slow*. When switching the fan off and on again, the rotor case movement shall be restored. You may decide for yourself if the fan should be switched on or off by default.

The following functions are already implemented:

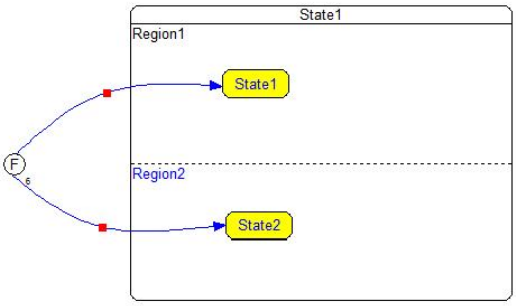
- `writeLine0(-1)` displays ”OFF” on the LCD.
- `writeLine0(0)` displays ”Speed: slow” on the LCD.
- `writeLine0(1)` displays”Speed: med” on the LCD.
- `writeLine0(2)` displays ”Speed: fast” on the LCD.
- `writeLine1(0)` displays ”Moving: yes” on the LCD.
- `writeLine1(1)` displays ”Moving: no” on the LCD.

Remarks:

To create an AND state, insert a ”Composite-State”. Afterwards, click on the state using the right mouse button, choose ”Insert Region” and then, e.g., ”Above”.



To activate an AND state’s substates via a transition, it is not sufficient to drag the transition onto the AND state. In such cases, the transition must point to a fork node, starting at which another transition must be drawn to the substates, as evident from the following figure:



For leaving the AND state, a transition from the AND state to the subsequent state can be created as usual.

General information: An overview about the exercise sessions as well as further information can be found on `https://ls12-www.cs.tu-dortmund.de/daes/en/lehre/courses/sommersemester-2018/cyber-physical-system-fundamentals-ss-2018.html`. The exercise sheets will usually be published on the course website on Mondays and will be solved during the respective exercise sessions. The exercises are divided into two parts, in each of which at least 50% of the points must be achieved in order to receive the exam admission.