

Exercise 4: Green house

Description

In this laboratory exercise, the operation of a smart greenhouse is implemented. At this greenhouse the following elements are used:

1. An Analog to Digital Converter (ADC), which
which receives values from a humidity sensor.
- 2 . A timer/counter element.
3. A Pulse-Width Modulator (PWM).
4. Three LEDs (LED0, LED1, LED2 of the PORTD).
5. Two switches (SW5 and SW6 of PORTF).

Initially, the ADC is activated, which continuously receives values and controls them according to two humidity thresholds. If the values are lower than the threshold, then the PORTD LED0 is activated, which signals that the greenhouse plants need to be watered. If the values are greater than the threshold set, then PORTD LED1 is activated signalling that the humidity has exceeded the desired levels and must be lowered via a ventilation system (automatic doors, windows or a fan system which activated by a motor to renew the air in the greenhouse).

Assumptions

Depending on the LED that has been activated (LED0 or LED1) and via the two switches (switches 5 and 6 of the PORTF), the user can select the next action to be performed by the greenhouse system. By activating switch SW5 of the PORTF, the watering system is activated. This operation will be simulated with the timer (timer/counter), which will operate for a period of time calculated by subtracting the lower permissible threshold of humidity from the last value converted by the the ADC. Once the calculated time interval has elapsed, the timer/counter and LED0 shall be deactivated, and the system shall return to its initial operation, in which it shall wait the next ADC conversion. By turning on PORTF switch SW6, the system ventilation system is activated. This operation will be simulated by a PWM pulse, which will drive the LED2 of PORTD with a period $T_1 = 1$ ms and a duty cycle $D_1 = 50\%$. LED2 based on this pulse, will be switched on or off respectively on each rising edge. THE PWM pulse and the activated LEDs (LED1 and LED2) will be switched off completely when four rising edges of the pulse. Thereafter, the system will return to the initial operation, i.e. it will wait for the next ADC conversion. Therefore, according to the LED that has been activated, based on the ADC readings, the the user can understand which switch, i.e. which function, should be activated. However, the user may activate the wrong system, i.e. a switch other than the one indicated by the two LEDs may be pressed. In this case, all three LEDs are activated, warning the user that a function other than the desired one is being performed. The LEDs are switched off by step-by-step.

Exercise Questions

1. Activate the initial system operation, i.e. the ADC mode with the two humidity thresholds. Depending on the comparison condition that applies at the time, the corresponding LED (LED0 or LED1) is activated.
2. Add the two system functions, i.e. the watering function (activation of a timer/counter) and ventilation (activation of a PWM), which are executed depending on the switch (SW5 or SW6) selected by the user.
3. Implement the function that alerts the user in case of incorrect button input (i.e. activation of all LEDs).