

# MELODI

*Mass E-Learning of design, test, and prototyping DIgital hardware*

## LEVEL 3

### LLS (Light-Barrier LED Servo)

In this task you have to control a servo motor. The angle of the servo arm is controlled via a **PWM** with **50Hz**. In addition, you can control the respective LEDs individually. Light barriers are used for the position detection of the arm, which you can also read out individually. For the detailed control of the servo motor, please refer to the *[Level 1]/Servo: Wave the Flag*. Write a design that starts with an initial position and changes to three other positions defined by the state of two buttons. Whenever the servo arm is detected by a light barrier, the corresponding LED as well as a VIRTUAL FLAG has to be enabled - the detailed description can be seen in *Table 1*.

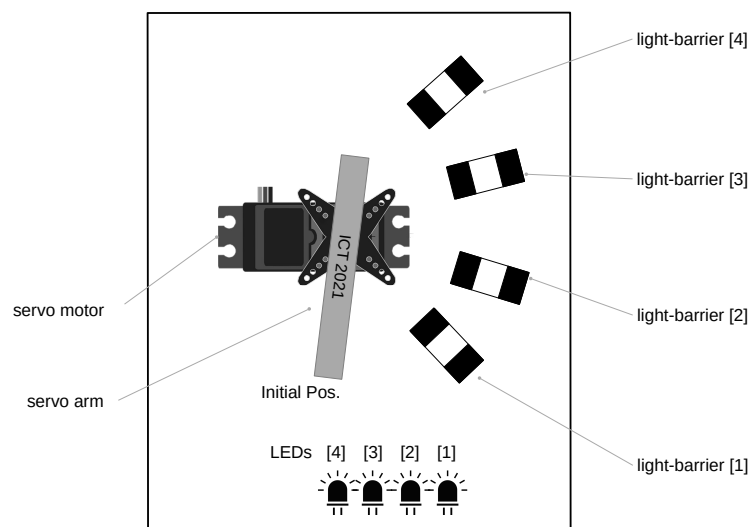


Figure 1: Details of the LLS Task.

States					
Button [0]	Button [1]	Duty	Position	LED on	Virtual Flag
0	0	5%	Init	-	-
1	0	8.5%	light-barrier [1]	[1]	[0]
0	1	11%	light-barrier [2]	[2]	[1]
1	1	13%	light-barrier [3]	[3]	[2]

Table 1: Required system states.

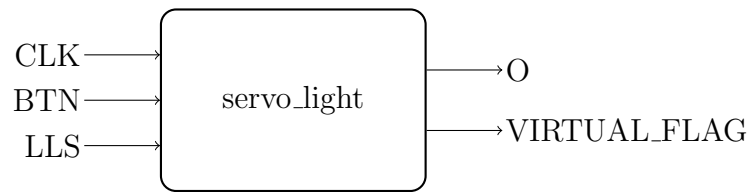
LLS Control		
Component	Port	Value
servo motor	O[0]	'0' / '1'
led [1]	O[1]	'1'=ON / '0'=OFF
led [2]	O[2]	'1'=ON / '0'=OFF
led [3]	O[3]	'1'=ON / '0'=OFF
led [4]	O[4]	'1'=ON / '0'=OFF
ligt-barrier [1]	LLS[0]	'1'=DETECTED / '0'=NOT_DETECTED
ligt-barrier [2]	LLS[1]	'1'=DETECTED / '0'=NOT_DETECTED
ligt-barrier [3]	LLS[2]	'1'=DETECTED / '0'=NOT_DETECTED
ligt-barrier [4]	LLS[3]	'1'=DETECTED / '0'=NOT_DETECTED
virtual flag 1	VIRTUAL_FLAG[0]	'1'=ENABLE / '0'=DISABLE
virtual flag 2	VIRTUAL_FLAG[1]	'1'=ENABLE / '0'=DISABLE
virtual flag 3	VIRTUAL_FLAG[2]	'1'=ENABLE / '0'=DISABLE
virtual flag 4	VIRTUAL_FLAG[3]	'1'=ENABLE / '0'=DISABLE

Table 2: LLS Control.

## Entity

Your task is to program the behavior of an entity called “servo\_light”. This entity is declared in the attached file “servo\_light.vhdl” and has the following properties:

- Input: CLK (100MHz) with type std\_logic
- Input: BTN with type std\_logic\_vector of length 2
- Input: LLS with type std\_logic\_vector of length 4
- Output: O with type std\_logic\_vector of length 5
- Output: VIRTUAL\_FLAG with type std\_logic\_vector of length 4



Do not change the file “servo\_light.vhdl”.

To turn in your solution write an email to [vhdlabgabe+e384@tuwien.ac.at](mailto:vhdlabgabe+e384@tuwien.ac.at) with subject “Result Task 3” and attach your behavior file(s):

- “servo\_light\_beh.vhdl”

Good Luck and May the Force be with you.