DEVELOPMENT OF A HARDWARE CONTROL INTERFACE USING A WWW FRONT-END

1. Goals of the laboratory sessions

The goal of the sessions will consist in the development and verification of a control interface for the hardware components that are present in the application. This control interface has to be managed using a web browser. Therefore, it will be necessary to create a C program able to generate dynamic HTML code, as it was already introduced in the laboratory session P1. In this case the code HTML generated from the C program should be able to manage the communication between the software components (SC12 device) and the hardware components (programmable logic) constituting the system.

2. Introduction

The physical interface between the SC12 device and the programmable logic in charge of managing the sensors and actuators present in the application will be constructed using some programmable input/output lines of the SC12 device and its AD bus.

Regarding the programmable input/output lines that will be used to create this interface, table 1 specifies their mapping, as well as the intended function they should perform.

PIO	Signal	Function
0	clearn	Synchronous reset (active low) for the programmable logic
1	capture	Indicates (high level) to the programmable logia that the image capture is enabled
5	configure	Indicates (low level) to the programmable logia that the digital camera is to be configured

Table 1. Specifications for the programmable input/output lines to be used in order to communicate the SC12 device with the programmable logic

Regarding the interface implemented with the AD bus of the SC12 device, this will be used to send commands to the programmable logic.

The programmable logic will be mapped in the address 0x0000 of the input/output space. Therefore, the signal PCS0# (active low) will be used to enable the programmable logic to read the data present in the AD bus. To enable the use of the AD bus it is possible to use the function “EnableBusAD” included in the file “hard.c”. When using this function it is worth noting that the programmable logic is mapped in a single address. Therefore, this address does not need to be registered, and as a consequence the ALE signal may be disabled. The programmable logic will register the data present in the AD bus when the condition ***(PCS0#= ‘0’) and (RD# = ‘1’)*** is met. This will imply that a write access on the address 0x0000 of the input/output space is being carried out.

The actions to be managed from the control interface can be grouped in 10 action groups:

- **Exposure time:** Permits to modify the exposure time of the camera among 8 possible values.
- **Gain control:** Determines the gain of the sensor included in the camera. It is possible to choose among 8 different gain values.
- **Gamma value:** This parameter permits to define the two possible values for the gamma of the camera.
- **Mirror image:** With this action it is possible to determine if the image captured by the camera will be mirrored or not.
- **Indoor/outdoor image:** This option determines if the environment where the images are captured corresponds to an indoor or an outdoor situation.
- **Backlight compensation:** Permits to activate the backlight compensation function present in the camera.
- **Restore initial values:** With this function it will be possible to restore the configuration parameters of the camera to their initial values.
- **Camera movement:** Determines the main possible movement actions on the camera, as well as the two basic operating modes (scanning and movement detection).
- **Capture enable:** With this action the camera is enabled to capture images.
- **Capture disable:** With this action the camera is disabled to capture images.

Table 2 shows the values corresponding to the exposure time action, as well as the respective values to be written on the AD bus.

Value	Data on the AD bus
Exposure time 0 (maximum)	20
Exposure time 1	19
Exposure time 2	18
Exposure time 3	17
Exposure time 4	16
Exposure time 5	15
Exposure time 6	14
Exposure time 7 (minimum)	13

Table 2. Values corresponding to the exposure time action

Table 3 shows the possible values corresponding to the gain control action, as well as the respective values to be written on the AD bus.

Value	Data on the AD bus
Gain = 0.0 dB	12
Gain = 2.6 dB	11
Gain = 5.2 dB	10
Gain = 7.7 dB	9
Gain = 10.3 dB	8
Gain = 12.9 dB	7
Gain = 15.4 dB	6
Gain = 18.0 dB	5

Table 3. Possible values for the gain

Table 4 shows the possible values for the gamma value action, as well as the respective values to be written on the AD bus.

Value	Data on the AD bus
Gamma = 0.45	30
Gamma = 1	31

Table 4. Possible values for the gamma

Table 5 shows the possible values for the mirror image action, as well as the respective values to be written on the AD bus.

Value	Data on the AD bus
Mirror image enabled	29
Mirror image disabled	28

Table 5. Possible values for the mirror image

Table 6 shows the possible values for the backlight compensation action, as well as the respective values to be written on the AD bus.

Value	Data on the AD bus
Enable backlight compensation	25
Disable backlight compensation	24

Table 6. Possible values for the backlight compensation

Table 7 shows the possible values for the indoor/outdoor action, as well as the respective values to be written on the AD bus.

Value	Data on the AD bus
Indoor image	27
Outdoor image	26

Table 7. Possible values for the indoor/outdoor image action

When the user chooses the action restore initial values it will be necessary to write sequentially on the AD bus the values 4, 12 and 20.

Table 8 shows the possible values for the camera movement action, as well as the respective values to be written on the AD bus.

Value	Data on the AD bus
Initial position	50
Scanning mode	51
Movement detection mode	52
Stop the camera	53
Move a step up	54
Move a step right	55
Move a step left	56
Move a step down	57

Table 8. Possible values for the camera movement action

The capture enable/disable actions will act directly on the PIO1 programmable input/output line. This line will be used to communicate the SC12 device with the programmable logic.

3. Specification of the development

Starting from the files provided for the laboratory session P1, a new control interface has to be designed in order to perform the proposed control actions on the programmable logic.

Regarding the HTML interface, the home page has to be the same as that provided for the laboratory session P1. The management page (Index) has to be modified so as to permit the proposed actions. This interface will be structured as a table composed of two columns, as specified for the laboratory session P1. The left column will be called MENU, and it will contain the 10 proposed action groups. The right column will be called OPTIONS, and it will contain (if there are) the options available for the chosen action. When the link corresponding to a given action is clicked the right column should display (if there are) the options available for this action. Furthermore, this right column should permanently display on its bottom if the image capture is enabled or disabled.

In order to use the AD bus correctly it has to be initialised. To do it at the beginning of the main program, proc.c, the following calls have to be inserted:

```
/* AD bus initialisation */
EnableBusAD( 0 );
EnablePCS( 0 );
```

During the initialisation phase a reset of the programmable logic has to be issued. This reset state should have a duration of 20 ms.
Once the C program with the requested functions has been developed the resulting executable code has to be uploaded in the SC12 device. Once executed, the logic analyser will be used in order to verify that the application is working correctly.
The signals to be monitored in the logic analyser are the following:

- PIO0
- PIO1
- PIO5
- PCS0#
- RD#
- AD0
- AD1
- AD2
- AD3
- AD4
- AD5

These signals are identified and properly labelled on the board that contains the SC12 device.