3rd Assignment in the Course "Microprocessors"

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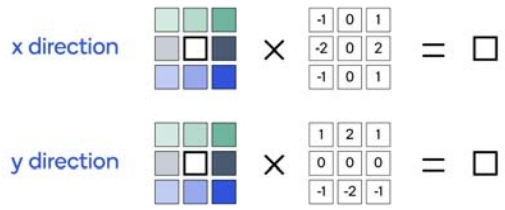
The project is individual and should be implemented in x86 assembly language. You can implement the project in any assembler you want but I suggest you use MASM in Visual Studio environment (free version).



The purpose of the project is to implement the basic kernels of the Sobel edge detection algorithm in x86 Assembly. The image management parts (reading the original bmp file and saving the final result will be done by the C programming language). The parameter passing between C-Assembly will be done through the stack.

You are given a ready-made program in C that implements the Sobel algorithm and sample input and output images.

There are enough comments in the C file to help you understand the steps of the algorithm. In total, there are 3 C functions that need to be implemented in x86 Assembly. These are:

First function: Converting to gray-scale images (1 unit)

Converting the input RGB bmp to grayscale image (not black and white):

```
int bmptogray_conversion(int height,
                         int width,
                         RGBQUAD input_color[2048][2048],
                         int output_gray[2048][2048]);;
```

You should NOT use floating-point operations in the implementation of this function. Think of some way to do this. In general we would like to achieve an accuracy of 2 decimal places.

Second function: Implementation of the Sobel algorithm (2 units)

Edge Detection with Sobel:

```
int sobel_detection(int height,
                    int width,
                    int input_gray_image[2048][2048],
                    unsigned char output_ee_image[2048][2048]);;
```

In the implementation of this function you must use floating-point operations (the FPU).

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Third function: Calculation of pixels at the edges of the image (1 unit)

Calculating the border pixels with replication:

```
int border_pixel_calculation(int height,
                             int width,
                             unsigned char ee_image[2048][2048]););
```

In the implementation of this function you should use SIMD (MMX, AVX) type commands.

Steps

Study the C code before proceeding to implement the corresponding kernels in assembly. The sensitivity of the algorithm is defined by a threshold which is declared in the original code as define.

Information on edge detection algorithms can be found here: https://en.wikipedia.org/wiki/Edge_detection

Information on the Sobel method can be found here:

https://en.wikipedia.org/wiki/Sobel_operator

Deliverables

The deliverables of the project will be the C-Assembly code with sufficient comments (about 60% of the code should be comments) and an output image of the algorithm.

Delivery Date

The deadline for delivery of the project is 18 February 2024 (end of the examination period).

Scoring method

The project is not compulsory. You can do as many parts of the exercise as you want. The first part (function) corresponds to 10% of the final grade, the second part (function) corresponds to 20% and the third part (function) corresponds to 10%.