UNIVERSIDADE da MADEIRA

Evaluation Component P3 (15%) of Computer Architecture

School Year: 2022/2023

Delivery and discussion date: 24-05-2023

## 1. Description of the third practical evaluation work: Entrance management system in a car parking lot

In the third evaluation work, it is intended to develop a program in assembly language and C language for the 8051 microcontroller. The program must be capable of managing the entrance of a car to a car parking lot.

**Parking lot entrance management system requirements:**

**S1:** at the entrance to the car park there is an optical sensor that detects the passage of a car. When there is no car passing by, the output value of the sensor is a logic '1'. While the car enters the parking lot and blocks the optical beam, the output of the sensor is a logic ‘0’.

**S2:** at the exit of the car park there is an optical sensor that detects the passage of a car. The operation of sensor **S2** is similar to the operation of sensor **S1**.

**Green1 and Red1**: **Green1** corresponds to the green light and **Red1** corresponds to the red light, placed at the entrance to the car park. Green light is normally on, and red light is normally off.

**Green2 and Red2**: **Green2** corresponds to the green light and **Red2** corresponds to the red light, placed at the exit of the car park. Green light is normally on, and red light is normally off.

When a car **enters** the parking lot, the Green1 and Red2 lights are **on** and the Red1 and Green2 lights are **off**, to signal the vehicle's **entry** into the parking lot.

When a car **leaves** the parking lot, the Green1 and Red2 lights are **off** and the Red1 and Green2 lights are **on**, to signal the vehicle **leaving** the parking lot.

**Yellow**: additionally, there is a yellow light, which flashes every second, for five seconds, while a vehicle enters or leaves the car park. After the five seconds is assumed the vehicle have entered or left the parking lot, so the Green1 and Green2 lights are turned on and the Red1 and Red2 lights are turned off.

**D1**: D1 is a 7-segment display that shows the number of spaces available in the car park. The car park has a capacity of 9 spaces. At each entry of a car, this number is decremented and at each exit of a car, this number is incremented. The range of values that the 7-segment display can show is between the number 9 (park empty) and the number 0 (park full). At the beginning of the program, the park is empty.

**Description of microcontroller connections:**

Figure 1 shows the diagram of the microcontroller connections that manages the entrances to the car park.

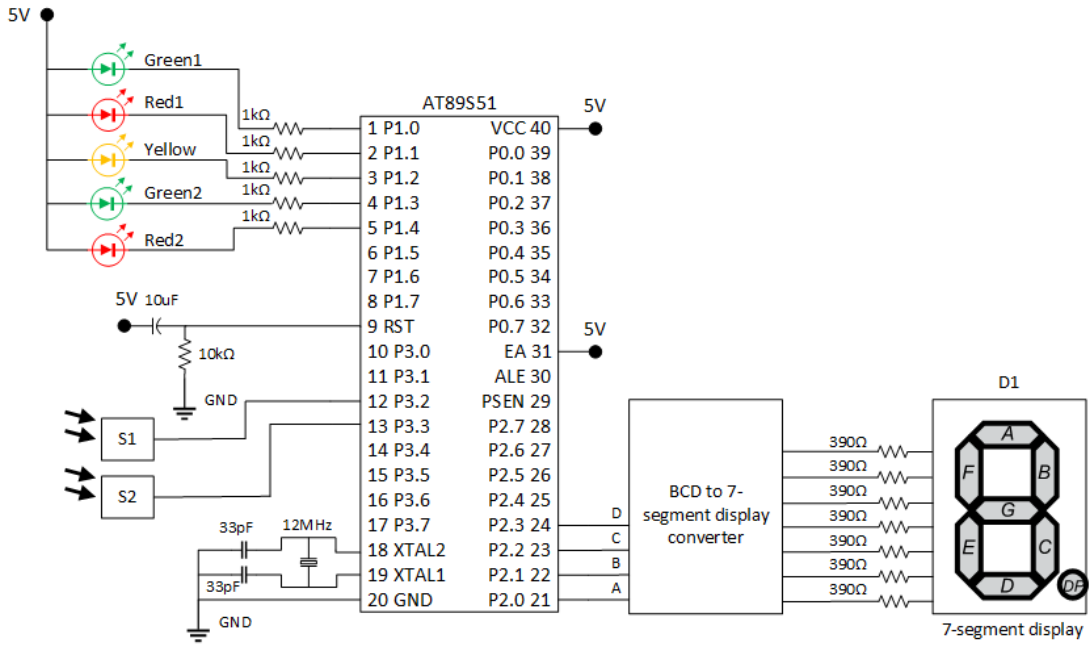


Figure 1 – Diagram of the microcontroller connections.

**Microcontroller pin mapping:**

Table 1 shows the mapping of the microcontroller pins.

Table 1 – Microcontroller pin mapping.

| Object | Microcontroller pin |
|---|---|
| Lights | |
| Green1 | P1.0 |
| Red1 | P1.1 |
| Yellow | P1.2 |
| Green2 | P1.3 |
| Red2 | P1.4 |
| Sensors | |
| S1 | P3.2 |
| S2 | P3.3 |
| Display | |
| A | P2.0 |
| B | P2.1 |
| C | P2.2 |
| D | P2.3 |

**7-segment display truth table:**

The 7-segment display used is common anode and is controlled by a BCD decoder for 7-segment display – SN74LS47. Table 2 represents the truth table that lists the value of inputs A, B, C and D of the BCD decoder for the 7-segment display and the corresponding decimal value that is shown on the 7-segment display.

Table 2 – 7-segment display truth table.

| Segments | | | | Value |
|---|---|---|---|---|
| D | C | B | A | Decimal |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 0 | 2 |
| 0 | 0 | 1 | 1 | 3 |
| 0 | 1 | 0 | 0 | 4 |
| 0 | 1 | 0 | 1 | 5 |
| 0 | 1 | 1 | 0 | 6 |
| 0 | 1 | 1 | 1 | 7 |
| 1 | 0 | 0 | 0 | 8 |
| 1 | 0 | 0 | 1 | 9 |

## 2. Work plan

The third practical work of evaluation of the discipline of Computer Architecture is divided into three phases, namely:

- Specification and drawing of the entrance management system in a car parking lot flowcharts;
- Programming in assembly and C languages;
- Implementation, testing, and writing of the report.

- Specification and drawing of the flowcharts
    - Drawing of the flowcharts of the main program and the external and time interrupt routines.

- Programming in assembly and C languages
    - Study of the languages for the microcontroller 8051;
    - Study of the configuration and programming of microcontroller interrupts;
    - Programming in assembly and C languages;
    - Simulation of the entrance management system in a car parking lot in the Keil uVision software.

- Implementation, testing and writing of the report
    - Experimental verification of the program;
    - Elaboration of a report with the description of the work carried out, in a maximum of 5 pages (not counting the annexes, cover and index);
        - Cover with the identification of the discipline, the teachers and the students;
        - Objectives;
        - Description of the solution and analysis of results;
        - Conclusion;
        - Bibliography;
        - Annex A: Flowcharts
        - Annex B: code in assembly and C languages, commented and organized in functions / routines.

## 3. Evaluation and relevant information

The project must be done individually or in groups of 2 students. It accounts for 15% of the final grade and has a minimum grade of 8/20.

The PDF report and the files with the programs should be compressed into a single ZIP/RAR file, which should be sent simultaneously to the Student Support Office ("trabalhos@uma.pt") and to teacher Pedro Camacho (pedro.camacho@staff.uma.pt) until midnight of the day 24-05-2023. In the e-mail you should indicate: your name and student's number, the name of the discipline, the work identification and the name of the teachers.

Plagiarism of the work implies its annulment.

The discussion of the work (24-05-2023) is individual, being necessary to show the program working correctly, without errors, in Keil uVision and in the electronic circuit, in at least one of

the programming languages. In this way, each student is asked to bring their own laptop, with the program open to not delay the discussion process.

GOOD LUCK!