INFO-2055: Embedded systems project

Hardware and software architecture

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1 Project idea

We are going to use a microcontroller to manage the maximum number of people allowed inside a shop in this period of health crisis.

Indeed, it will keep track of the number of people allowed to enter inside the shop. We will use an infra-red sensor system to detect customers entering and leaving the shop. In order to limit the customers flow, we will use seven segments to display the maximum number of customers that can still enter. After a reset, we will also use these seven segments display to configure the maximum number of customers that can be in the shop at the same time using buttons.

2 Hardware

2.1 Schematic

See *figure 1* for the schematic.

2.2 Components and circuit parts

The components[1] are available in the file `components.csv`. It is the shopping cart from farnell.be. We are not restrcited to these particular references. If it easier for you when doing the order, we have not problem with having other components as long as they have the same characteristics.
To detect people entering or exiting the shop we will use infrared. Thus, we will need 2 infrared emitters (Vishay TSHF5410) and 2 infrared receivers (Vishay TSOP2138).
To display the number of people that can still enter the shop, we will use two 7 segments. We choose the Multicomp Pro LS0565SRWK. This will allow up to 99 people in the shop which we considered to be enough for most shops. These 7 segments will also be used to set the maximum number of customers in the shop after a reset of the microcontroller.
As a microcontroller, we decided to stick to the Microchip PIC16F1789 used throughout the course because it fits our needs.
To power everything up, we will use a AC/DC power supply with a jack connector that outputs 5V. This is why we need the Switchcraft RAPC722X.
To hold everything, we will use a prototyping board. We choose the Roth Elektronik RE319-HP.
The other components in our list are common parts such as resistors and capacitors.

3 Software

3.1 Architecture

In order to realise this project, we will choose to adopt the round robin with interrupts architecture. Indeed, the round robin architecture is not suitable for us because we need interrupt mechanisms that will be used when one of the two sensors has detected the passage of a customer. Consequently, the operations carried out in these interrupts will be of short duration. In addition, because we want to use the simplest architecture suitable for our project, we believe that the use of a more complex architecture is not necessary: we do not need a notion of priority between tasks.

[1] Some components on the schematic are not in the `.csv` file because we already have them such as the buttons, the wires, and the power supply.

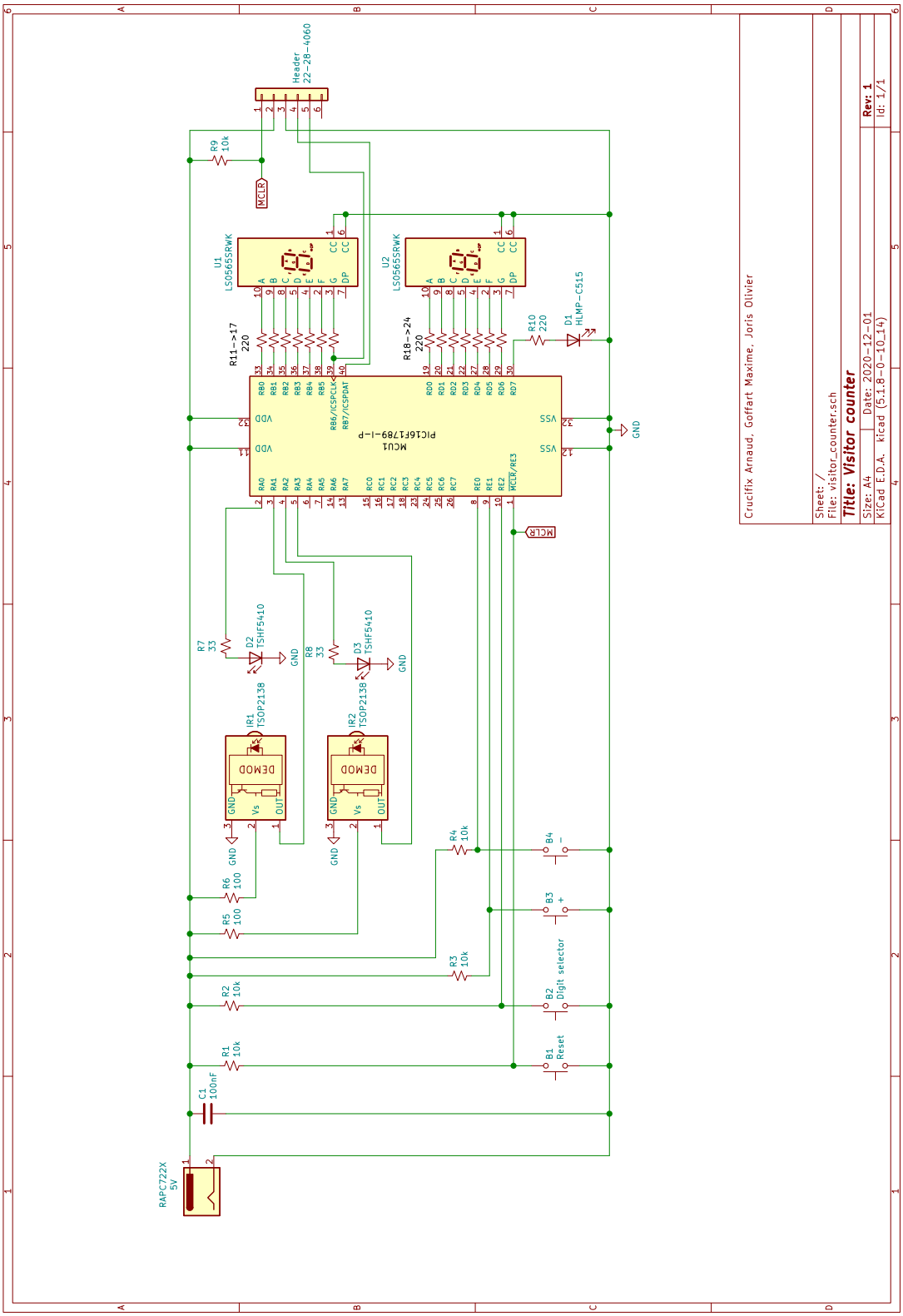

Figure 1: Schematic

3.2 Tasks and organization

The tasks carried out by our microcontroller are :

1. Set up the maximum number of customers that the shop can accept based on the value set with the buttons after a reset.
2. Configure outputs to display the number of customers that can still enter the shop on the two 7 segments displays.

The interrupts routines are :

1. Increment the allowed number of customers to enter when the corresponding sensor signal is received.
2. Decrement the allowed number of customers to enter when the corresponding sensor signal is received.

These tasks and interrupts will be organised according to this scheme :

```
volatile int customerNumber;
volatile BOOL reset = 1;

interrupt void enter() // Triggered by its associated sensor when someone enters the shop.
{
    !! Decrement customerNumber and deal with customerNumber = 0;
}

interrupt void exit() // Triggers by its associated sensor when someone leaves the shop.
{
    !! Increment customerNumber;
}

void main()
{
    for(;;)
    {
        if(reset)
        {
            !! Set up customerNumber;
            reset = 0;
        }

        !! Configure outputs values to display customerNumber on the 7 segments
        display;
    }
}
```