AUTOMATIC PEOPLE COUNTING CONTROL

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***Abstract* — Due to the current contingency that the whole world is going through because of the Covid-19 pandemic, where crowds must be avoided and the number of people in certain enclosed spaces must be controlled to maintain a minimum probability of contagion of the virus, an automated control system for counting people is needed to regulate the entry and exit in such places. So by means of the Curiosity Nano board (PIC16F15244) a people counter with a limit was developed. It has indicator LEDs that are activated when the maximum, average or minimum number of people is reached. This value can be modified through a configuration menu that allows to manually add or subtract the counter. The real-time value of the counter and the maximum value can be displayed on an LCD screen.**

I. OBJECTIVES

General:

- To design a digital electronic system for people counting and flow control.

Specific:

- To control and prevent people entering a local establishment, in order to avoid unwanted contagion.
- To design all the programmable code of the project in C language.
- To show the scale design of the project.

II. INTRODUCTION

A microcontroller is a chip or integrated circuit that contains all the elements of a CPU (Processor, RAM, ROM, I/O). These devices were born at the end of the 70′ decade to offer a solution to the expensive and complex systems based on discrete logic.
offer a solution to expensive and complex systems based on discrete logic; Today we see hundreds of applications where microcontrollers are used [1].

The microcontroller was born when integration techniques had progressed enough to allow its manufacture; but also because, very often, both in domestic applications and in industrial applications, "intelligent" or at least programmable systems are needed.

An embedded system (ES) is an electronic system that contains hardware and software elements tightly coupled to perform a single function or be part of something larger. [2]

Over time, technology has evolved in an amazing way, allowing processes to be automated for better control. Routine processes that are handled manually solve difficulties in a slow way, that is why bringing them to an automated system guarantees a better treatment of information and decreases the execution time of tasks performed through tedious processes for human beings. [3]

It is desired to design a software and hardware system that allows the automated counting of the entry and exit of a closed establishment, in order to keep track in an orderly and secure manner. This is due to the current situation that is presented worldwide by the pandemic, in which crowds of people are not allowed in very closed spaces. Facilitating the management and entry to be carried out by workers of different establishments through the use of electronic systems and the microcontroller 16f15244 is the best option for these processes.

III. Materials

- PIC16F15244-CNANO
- 7 resistors
- 3 LEDs
- LCD
- Buzzer
- 4 Photoresistor
- 4 Laser module emitter
- 3 Button
- 4 Transistors

IV. Desarrollo

1. For the design of this automated system, we first determined the problem and the methodology with which we wanted to solve the problem. An analysis of the possible solutions was made and the most appropriate to the requirements was chosen, keeping in mind the use of the knowledge seen during the course of digital electronics 2. This system must be developed by means of the microcontroller (PIC 16F15244).

2. Once the solution is chosen, a study of the possible materials which will be needed for the development of the system is made. After the analysis of different materials it was concluded to choose the most suitable components for the implementation of the final circuit taking into account a cost/quality ratio based on the budget that was available.

Table 1. Materials and costs to be used

Materials	Units	Price
Resistors	7	1400 $
Leds	3	900 $
LCD	1	17000 $
Buzzer	1	3000 $
Photoresistor	4	8000 $
Laser emmiter	4	24000 $
Button	3	6000 $
Transistors	4	1200 $

3. later by means of the PIC 16f15244 and with the help of its datasheet which explains about the handling and use of this microcontroller all the connections of each one of the necessary components to each one of the pins of the PIC will be defined.

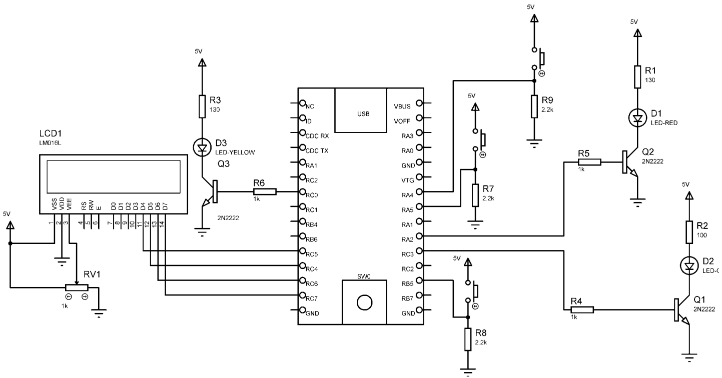

Figure1. Pic pin connections to external components.

- In addition to this, the resistance values for the protection of each of the LEDs and push buttons to be used were calculated by means of Kirchhoff's laws.

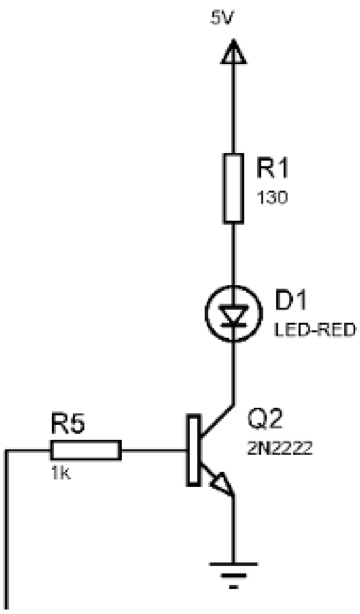

Figure 2. Kirchhoff's laws for red LEDs

For R1:

- R_1 = VCC-Vled-0.1/ IC (Ec1)
- R_1 = 5V-1.6-0.1/25mA
- R_1 = 132 ohm = 130-ohm commercial value

For R5:

- R_5 = 3.3v-0.7/2.5mA (Ec2)
- R_5 = 1 kohm

2. For green LED:

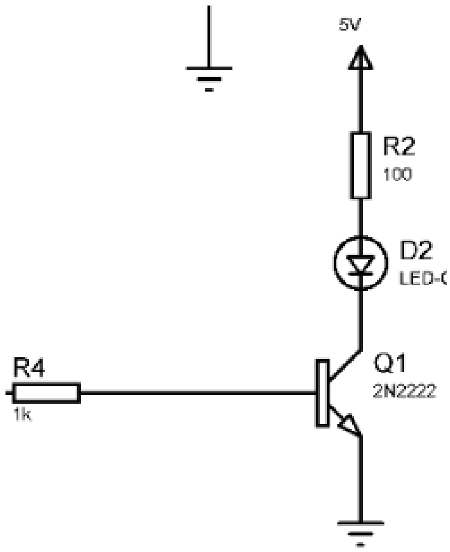

Figure 3. Kirchhoff's Laws for green LEDs

For R2:

- R_2 = VCC-Vled-0.1/ IC (Ec3)
- R_2 = 5V-2.4-0.1/25mA
- R_2 = 100 ohm comercial value

For R4:

- R_4 = 3.3v-0.7/2.5Ma (Ec4)
- R_4 = 1 kohm comercial value

3.For yellow led:

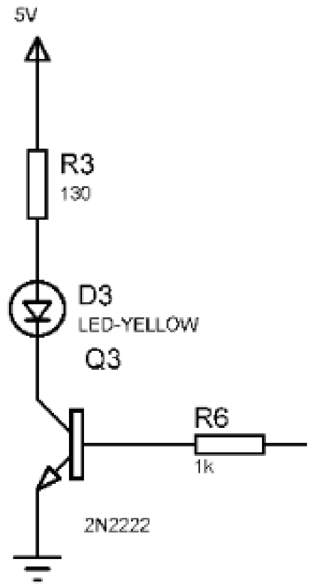

Figure 4. Kirchhoff's Laws for Yellow LEDs

For R3:

- R_3 = VCC-Vled-0.1/ IC (Ec5)
- R_3 = 5V-1.7-0.1/25mA
- R_3 = 128 ohm = 130 ohm comercial value

For R6:

- R_6 = 3.3v-0.7/2.5Ma (Ec6)
- R_6 = 1 kohm comercial value

4. The first part of the code is a bidirectional counter that depending on which button is activated first assigns values to the auxiliary variables and thus identify whether the person is entering or leaving. This also allows someone to be in front of the sensor for a long time without affecting the result of the counter.

The counter variable is 8 bits which corresponds to a maximum value of 255 decimal places. In case the counter reaches that maximum and enters a person the counter stays at 255 to avoid an overflow. The second part is a menu of instructions that allows to change the maximum number of persons. This maximum has a default value of 100.

Gestures such as holding the button down for a defined time or a single press are used to navigate through the menu. To enter the configuration, press and hold the button for 3 consecutive seconds; once inside, select the operation to be performed (addition or subtraction), then press for 3 consecutive seconds and choose how many times you want to perform the operation and finally press for 3 consecutive seconds to confirm the change and exit the menu. When you exit the menu the system returns to the counter mode, i.e. it means that the counter and the configuration menu are not developed at the same time.

Finally, there are two sensors, one for each door of the establishment; the first one is activated as an input sensor, which means that when someone enters the establishment, the sensor detects it by means of a photoresistance and makes the counter add a bit to the number of people, this is shown by means of the LCD. The other sensor is the output sensor, when a person crosses the infrared two is detected by another photoresistance, which indicates that there is a person who is leaving the place which makes the counter decreases by one bit the number of people, this is shown through the LCD already mentioned.

5. Finally, having the code ready, we proceed to assemble the prototype physically on the Protoboard with the components and connections already established previously, the code generated by MPLABX and its XC8 compiler is transferred to the Curiosity Nano card that will be in charge of programming the operation of each component so that they are executed as required, and comply with the functionalities specified at the beginning of the design as an automated people counting control.

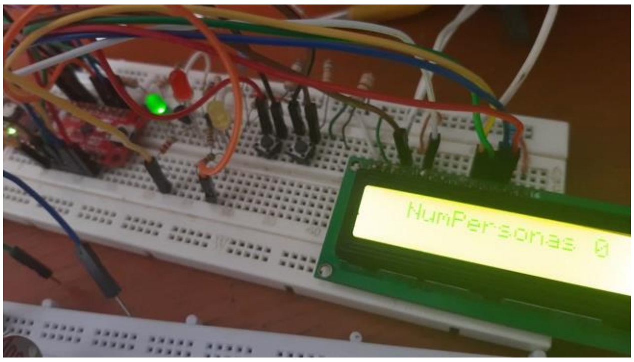

Figure 5. Result of the assembled prototype when the site is empty.

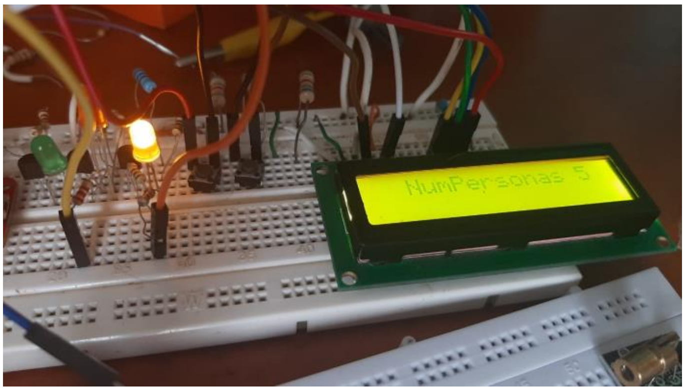

Figure 6. Result of the assembled prototype when the site is at a mid-top of its boundary.

Figure 7. Result of the assembled prototype when the site is at its maximum people limit.

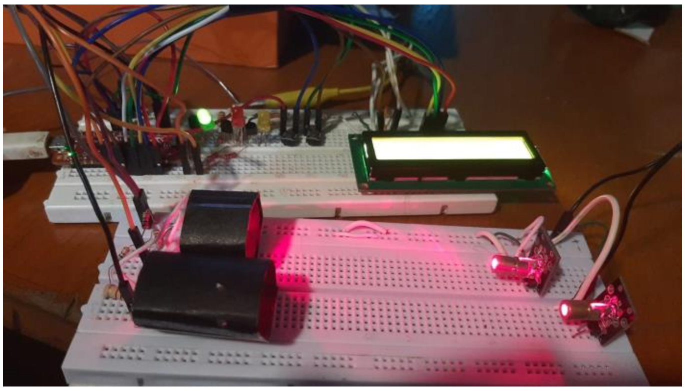

Figure 8. Final prototype with infrared and components working.

V. Conclusions

- It was possible to develop an adequate people counting and control system as proposed at the beginning of the project.
- Thanks to the C programming language, the pic 16f15244 was adequately controlled to meet the necessary requirements so that the other components of the project would work as desired.
- the purpose of warning when the local is unoccupied, is almost at its limit of people and when it exceeds it was achieved in order to prevent possible agglomerations that affect the health of people by the new pandemic.

References

[1] Nacho, M., 2020. Introducción A Los Microcontroladores. [online] Ikkaro. Available

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[3] Sandoval,J;2011. Analisis e implementacion de sistemas de control Available https://dspace.ups.edu.ec/bitstream/123456789/1636/14/UPS-CT002157.pdf