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Digital Weighing Machine

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ABSTRACT

After conducting research in the laboratories of the Technological University of Tlaxcala, we found problems with the weights provided by the weighing machines of the predictive maintenance and chemistry laboratories, then, we came to the conclusion to implement a digital weighing machine, this same one that It has certain characteristics that are ideal for obtaining good performance in terms of weighing materials, for the needs of students. Students will be able to count on this equipment to carry out their practices without worries about failing in the materials they wish to use when carrying out work. It is a very good tool because it meets the needs of these laboratories. The weighing machine that is proposed to be implemented as a loaded card that allows us to display three different weight units (ounces, grams, and milliliters), thus verifying the dimensions with narrow tolerances, these are shown in an electronic display module, in addition to being practical for use and transportation. Computer design in 3D software was the tool that allowed us to model this weighing machine in detail, since it requires small and more resistant equipment, to its design it gave us the accessibility to perfectly place the Atmega328p microcontroller and the rest of the components that make it.

Keywords: digital weighing machine; microcontroller; software

INTRODUCTION

Our digital weighing machine was built with a load card specially selected to show us three units of weight, and by pressing a button we changed their value. To show us the results, a 16cm by 2cm LCD screen is used. The design of the weighing machine was carried out with 3D software.

The margin of error sought when carrying out laboratory practices must be minimal since better work is needed every time, which is why equipment is essential for university students.

The main features of our digital weighing machine are the following:

Speed: When is placed material to be weighed on our prototype, will save time in the measurement conversion process, since it can be changed with the push of a button, this function was integrated into the program.

Efficiency: Regarding the product control with which it worked, so as evit not to waste it due to being calculated manually, the weight sensor was calibrated, to achieve better results than the scales in the chemistry laboratory.

Comfort: Convenience: The size of the finished digital weighing machine is 70 mm high and 115 mm wide, making it very small when working in places with little space and it also makes it easy to move and place

METHODOLOGY

The prototype is focused on the design and construction of a weighing system with 1 kilogram as the maximum capacity of solid material, which will have the appropriate elements and instrumentation to be able to change the weights and measure in different units.

To build with precision we rely on computer-aided design, and thus proceed with 3D printing.

3D design and construction

Right and left side wall design. The design of the walls of both sides of the prototype (right and left) was made to have a better assembly for assembling the digital weighing machine.

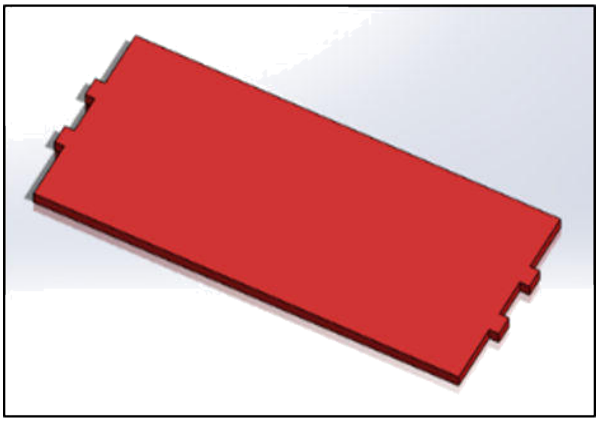

FIGURE 1: 3D left and right-side layout design.
Source: Own, year 2023.

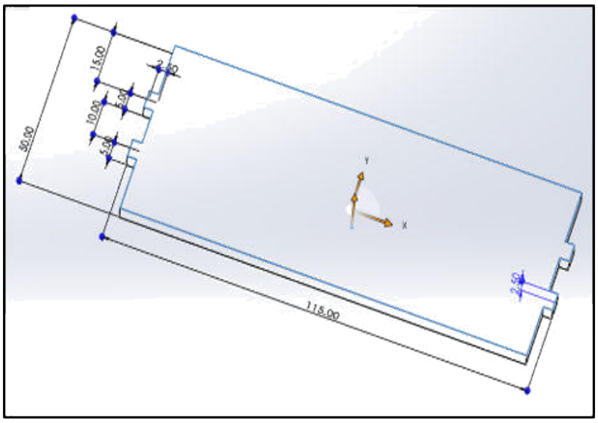

FIGURE 2: Side wall measures.
Source: Own, year 2023.

Back wall design: The rear wall is designed with two elements to join both ends with a hole for placing the power cable.

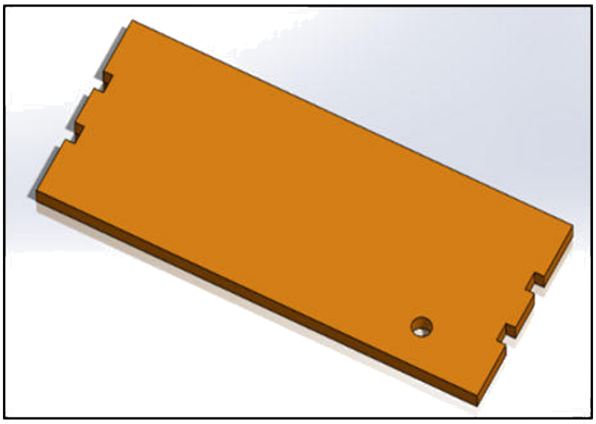

FIGURE 3: 3D back wall design.
Source: Own, year 2023.

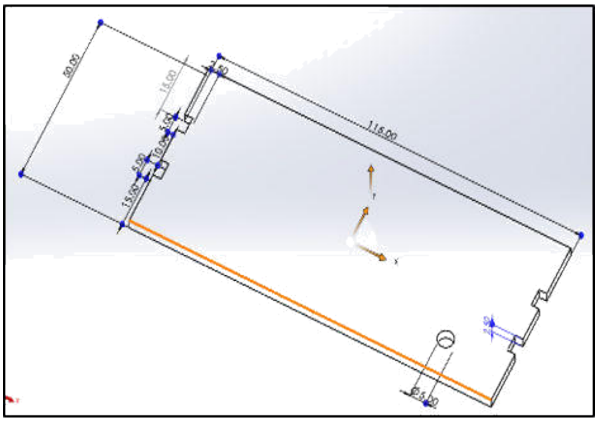

FIGURE 4: 3D back wall measures.
Source: Own, year 2023.

Front wall design: With two elements to join both ends with two holes for placing the puchs bottons cable, and an opening for placing the LCD screen.

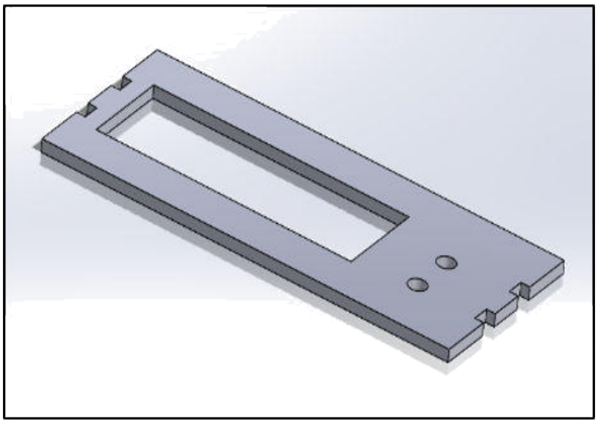

FIGURE 5A: 3D front wall design.
Source: Own, year 2023.

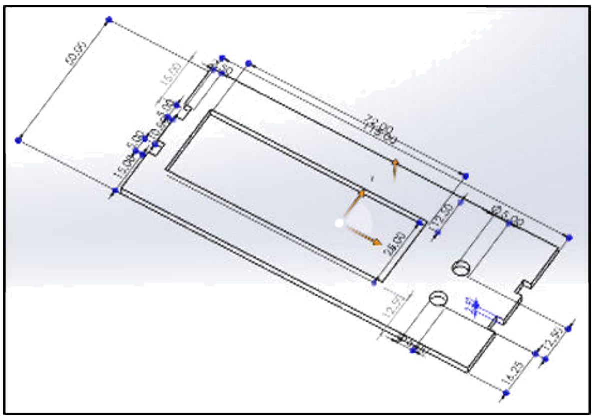

FIGURE 5B: 3D front wall measures.
Source: Own, year 2023.

Bottom cap design: Rear wall designed with two elements to join both ends with four holes placed in each corner for the union with the corners of the front, rear and side walls to have a better union.

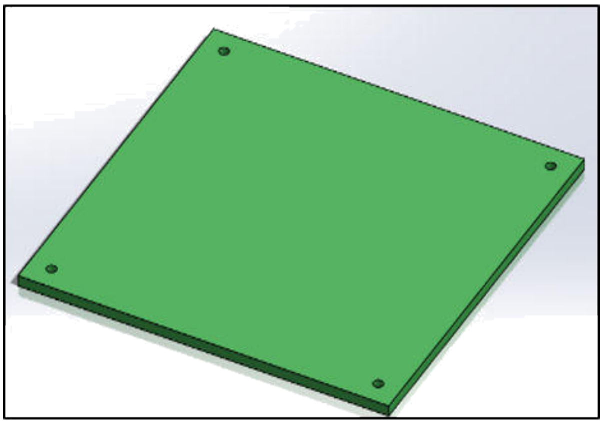

FIGURE 6: 3D bottom cover design.
Source: Own, year 2023.

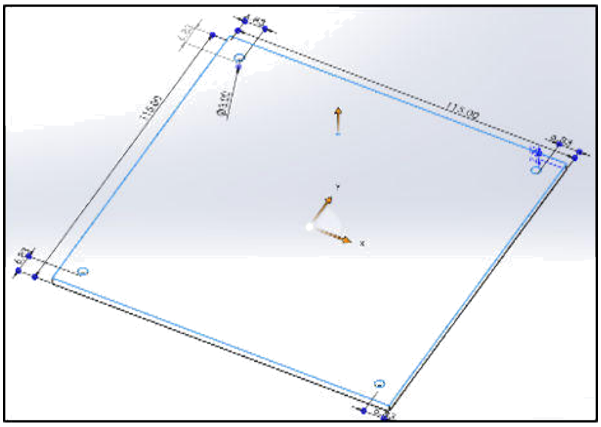

FIGURE 7: 3D bottom cover measures.
Source: Own, year 2023.

Upper gauge base design: Base designed for support, with two holes for placing the gauge.

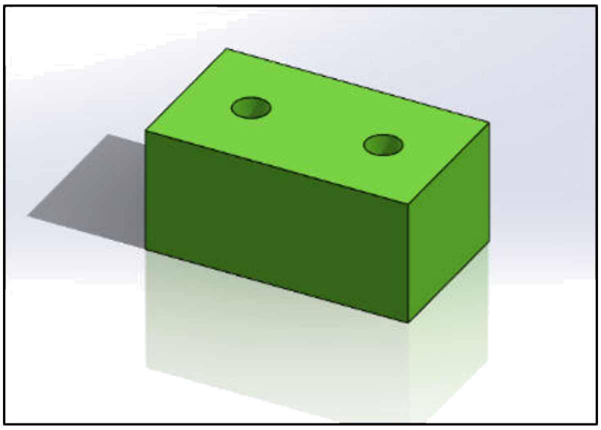

FIGURE 8: 3D upper base design.
Source: Own, year 2023.

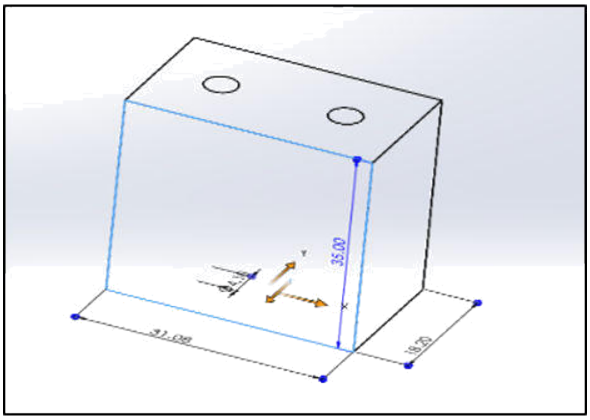

FIGURE 9: 3D upper base measures.
Source: Own, year 2023.

Bottom gauge base design: The base is designed for support, with two holes for placing the lower gauge.

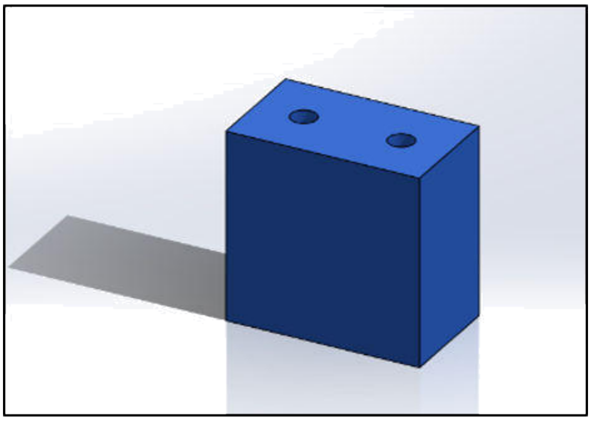

FIGURE 10: 3D Bottom gauge base design.
Source: Own, year 2023.

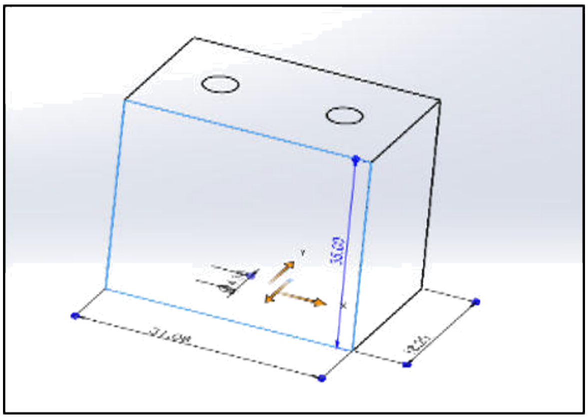

FIGURE 11: 3D Bottom gauge base measures.
Source: Own, year 2023.

Interior with base for the lower and upper gauge

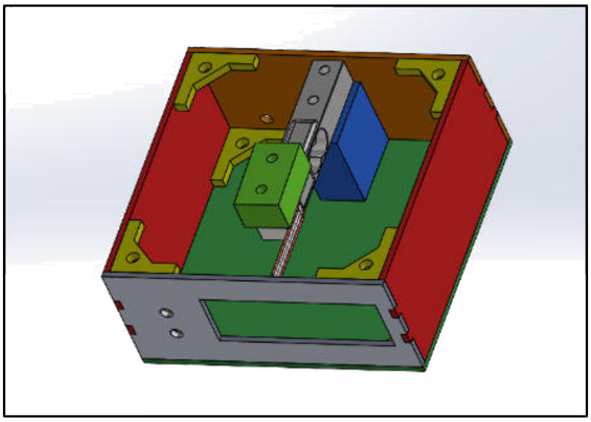

FIGURE 12: 3D Interior with base design.
Source: Own, year 2023.

Finishing all parts of the base together

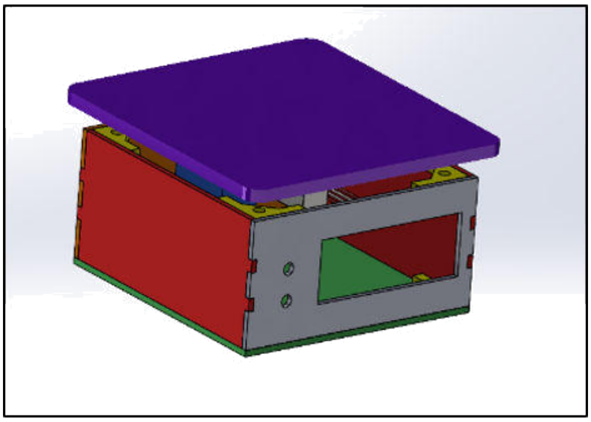

FIGURE 13: 3D Finishing all parts design.
Source: Own, year 2023.

Description compounts electronics

The selection of electronic components was selected by size and function as best suited to the size of the digital weighing machine.

Weight sensor: A weight sensor or load cell is an electronic device with a special technology that allows us to detect variations in the intensity of force or weight applied to the digital weighing machine and convert it into an electrical signal that is transmitted to the controller or weight indicator of said digital weighing machine.

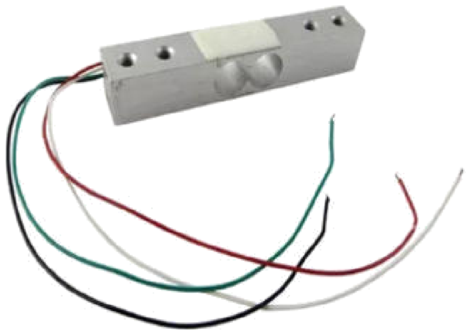

FIGURE 14: Weight sensor.
Source: Own, year 2023.

Microcontroller: The board was used as a microcontroller, loading the respective program from our computer and it works independently, controlling and powering the devices.

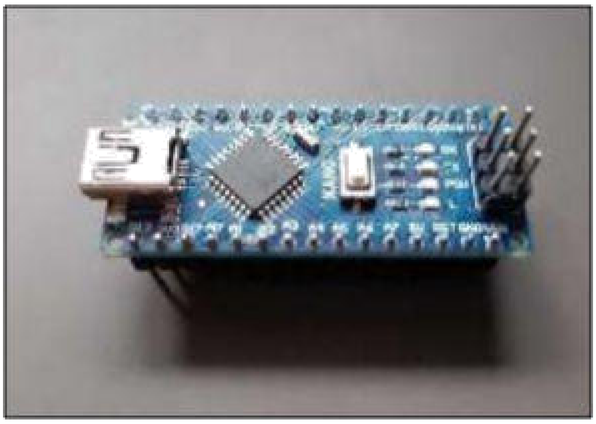

FIGURE 15: microcontroller.
Source: Own, year 2023.

LCD screen: The LCD screen where the results are displayed is 16 x 2cm. This type of screen requires many microcontroller pins because it uses a parallel design to communicate.

FIGURE 16: LCD screen.
Source: Own, year 2023.

HX711 module: To convert from analog to digital we use a 24-bit ADC designed for weighing digital weighing machines and industrial control applications to interface directly with a bridge sensor. The HX711 module was the transmitter between the load cells and the microcontroller, allowing the weight in the cell to be read easily. It is compatible with 1kg load cells.

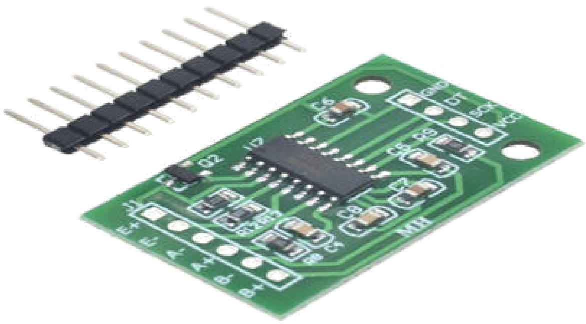

FIGURE 17: HX711 module
Source: Own, year 2023.

CONTROL DESIGN

The electrical connection was the way in which the electrical devices were connected, for the correct function of each of the electronic components that make up our prototype.

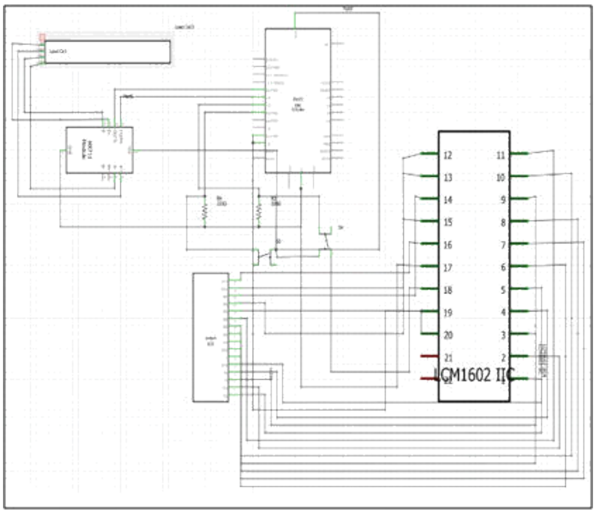

FIGURE 18: Control design.
Source: Own, year 2023.

One-way ANOVA (Anlatic, B Truper, B Prototipe,) summary report.

Do the averages differ?

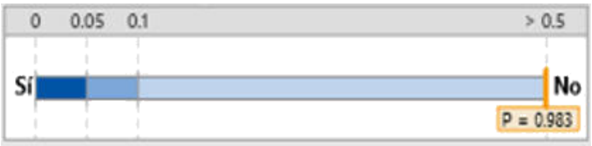

FIGURE 19: Averages differ.
Source: Own, year 2023.

The differences between the means are not significant (p<0.05)

One way ANOVA (Anlatic, B Truper, B Prototipe,) Diagnostic report.

Data distribution.
Compare location and dispersion.

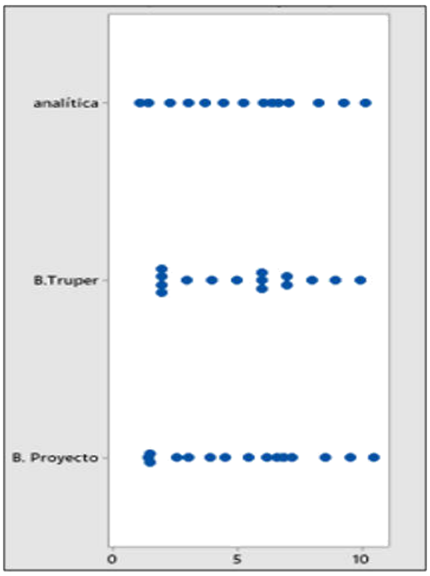

FIGURE 20: location and dispersion.
Source: Own, year 2023.

Order of data in the investigation.
Any outliers worksheet (marked in red).

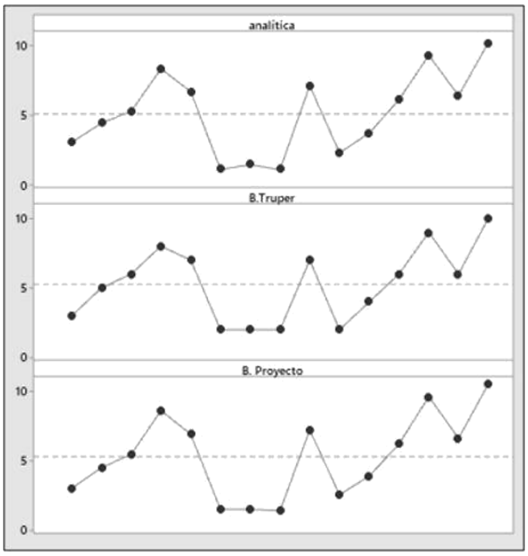

FIGURE 21: Order of data.
Source: Own, year 2023.

One-way ANOVA (Anlatic, B Truper, B Prototipe,) Report on power.

What is the probability of detecting a difference?

FIGURE 22: Report on power.
Source: Own, year 2023.

Based on your samples and a (0.05) you have a minimum 90% probability of detecting a difference of 4,0792 and a maximum 60% probability of detecting a difference of 2.7136.

CONCLUSIONS

It was achieved as a good alternative to make measurements when using the scale, even if the test results are not very different, the scale we created is still better. The tests were carried out in the laboratories of the Technological University of Tlaxcala.

As a final comment, what was expected was obtained, a piece of equipment that was easy to transport, efficient, and convincing for the students, so it met expectations.

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