DIGITAL DYNAMOMETER FOR STATIONARY WAVES

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Abstract - *This project describes the improvement of a digital dynamometer in the physics laboratory of the Technological University of Tlaxcala, implemented by engineering students in industrial maintenance. The digital dynamometer was made to measure the forces in a stationary wave system and to show the register of the forces in a LED screen. A compact cylinder and the hooks for the digital dynamometer were designed, an LED display and a pressure sensor were included to be able to show the results on the screen in digital form, the dynamometer was programmed in Arduino and was calibrated with metrological weights. The results shown on the LED dynamometer display showed the exact forces of the stationary wave system and the compact design of this dynamometer makes it easy to use. This project will be for use in the physics laboratory at the Technological University of Tlaxcala.*

1. INTRODUCTION

The present engineering project describes the process of design, construction, calibration and testing of a dynamometer and specifically for the measurement of the weight of objects, it is a design programmed for support in the physics laboratory, to analyze the force of an object in the practices developed in the laboratory previously mentioned.

One of the objectives of this project is to serve as a reference for the students of the Universidad Tecnológica De Tlaxcala for the people who carry out practices in the above mentioned laboratory. Finally, it seeks that the students make use of the analysis of efforts generated and that they can verify the results obtained.

The dynamometer is an instrument used to measure forces or to calculate the mass of objects. The traditional dynamometer, invented by Isaac Newton, bases its operation on the stretching of a spring that follows Hooke's law of elasticity in the measuring range. Like a spring-loaded scale, it is a spring scale, but should not be confused with a pan scale (an instrument used to compare masses).

These instruments consist of a spring, usually contained in a cylinder which in turn can be inserted into another cylinder. The device has two hooks or rings, one at each end. The dynamometers are marked with a scale on the hollow cylinder surrounding the spring. When hanging weights or exerting a force on the outer hook, the cursor at that end moves over the outer scale, indicating the value of the force. The dynamometer works thanks to a spring or spiral inside, which can be lengthened when a force is applied to it. A tip or indicator usually shows, in parallel, the force. Through radio waves. Like a GSM mobile phone, a GSM modem requires a SIM card in order to operate.

2. DEVELOPMENT

As an instrument, the dynamometer is used to measure forces or to weigh objects. In a traditional sense, it is a device invented by Isaac newton based on Hooke's law of elasticity in a measuring range.

For the construction of a digital dynamometer was integrated a load cell that determines the maximum capacity, a display that shows the value of the force measured. The display is an LED screen, because it does not need external power, since with the internal batteries a portable and autonomous tool is obtained.

The dynamometer works through a sensor that determines the force applied, using a sensor is to make a more compact and portable design. The LED display and sensor were programmed in Arduino.

The Arduino is an open platform that facilitates the programming of a microcontroller. Microcontrollers surround us in our daily lives, using sensors to listen to the physical world and actuators to interact with the physical world. Microcontrollers read from sensors and write about actuators.

Arduino can be used to create autonomous elements, connecting to devices and interacting with both hardware and software.

In the design of this dynamometer we made sketches of the parts that integrate it, for the design of the parts we used the SolidWorks software.

SolidWorks is computer-aided 3D design software for modeling pizas, 3D assemblies, and 2D drawings. Its products offer the ability to create, design, simulate, fabricate, publish, and manage design process data. At the end of the dynamometer sketch, the designed parts were printed in 3D.

3D printing is a technique that allows us to create 3D pieces, i.e. with height, width and length of any design stored in a computer file created by the user.

ARDUINO programming was used for the development of this article as it is an open source electronic creation platform, which is based on free hardware and software, flexible and easy to use.

Fig- 1: Arduino logo

As a sensor, the circular resistive force pressure 0.5 fsr pressure was used, because it has the characteristics we are looking for our dynamometer since its size and pressure capacity.

Fig- 2: pressure sensor

For the pressure sensor to show the weight obtained it was decided to install a screen oled model: Screen Lcd 0.91 128x32 Serial, for its low power consumption and the size contained.

Fig- 3 Oled screen

To introduce the arduino code we handle the Arduino nano for its small, complete and friendly board is based on the ATmega328 (Arduino Nano 3.x) but in its SMD version that reduces the size considerably. It has 14 input/output pins 6 of them are PWM.

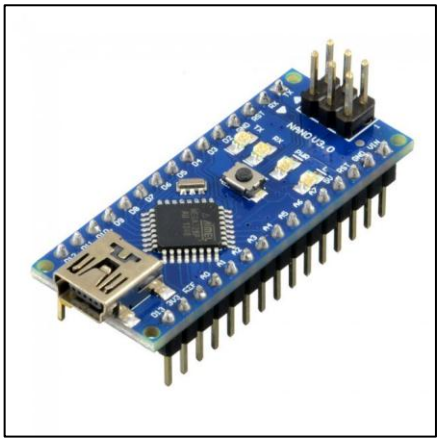

Fig- 4: Arduino nano

Instrumentation

The measurement of the magnitude of the force applied shall be carried out with a dynamometer, which shall be at least:

- To determine the initial force and the supporting force.
- To allow peak measurements, (reading setting) for initial and maximum force.
- To allow to measure thrust and drag, signaling it in the reading.
- To allow its use with different accessories according to the task to evaluate.

The dynamometer: it must be calibrated periodically according to the instructions given by the manufacturer, which implies having the corresponding certificate or manual.

Field Calibration: the equipment must be calibrated before starting the measurement, according to the instructions given by the manufacturer.

These accessories: facilitate the attachment of the sensor to the trolley or object, for example, chains and hooks are used for tasks where a traction or drag is executed, as well as hanging or lifting objects.

Contact accessories: on the other hand, used to hold firmly to a certain point, preventing them from slipping or moving from one position to another, and are used especially in load pushing tasks.

3. CONCLUSIONS

At the end of this project we conclude that:

The project was satisfy with the objective of being smaller and that its use would be more profitable in the physics laboratory of the technological university of Tlaxcala for the standing wave equipment.

Fig- 5: Dynamometer 1

Fig- 6: Dynamometer 2

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