Triaxial vibration meter

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Abstract.

Vibration is a phenomenon that originates from the rise of materials of any type, or, through the application of an electric current that will be converted into mechanical energy generating waves (vibration), this phenomenon is popular in predictive industrial maintenance. Nowadays there are countless devices that are used to measure it, but most of them are expensive.

Through research into the operation of professional devices, a design of a triaxial vibration meter was carried out at a low cost with a variation of measurements similar to those of a professional device on the market.

This device aims to increase the efficiency of predictive maintenance in the application of industrial motor monitoring. Within the design of this device, some improvements are suggested that can be applied to the device to increase the quality of the material or, failing that, the operating material

. Keywords: vibration, phenomenon, predictive, variation, industrial motors.

Justification.

Much of the equipment for vibration measurement usually has a wide list of applications for more uses of the equipment, and tends to be high in cost.

That is why it was decided to design a prototype capable of measuring only vibrations in machines and at a low cost.

This project has the purpose of being able to provide a necessary measurement for machinery and motor equipment and thus help facilitate the identification of failures in said equipment, which will be implemented in predictive maintenance.

Thus, it also solves the problem generated by the measurement of vibrations in drive equipment and its laborious process both in industry and in less relevant equipment.

Design a mechanical vibration analysis prototype that is functional and low-cost through programming and control with ATMEGA328, in order to increase the efficiency of predictive maintenance.

Likewise, implement a vibration measurement instrument that can record vibration data at a specified time in order to streamline predictive maintenance processes and thus minimize costs.

Introduction..

Today, vibration isolation and reduction technologies are an integral part of the design of all types of machines. Therefore, the need to accurately measure and analyze mechanical vibrations has increased. The measurement and analysis process is conveniently carried out with the help of modern electronics, using accelerometers that convert vibration movement into an electrical signal.

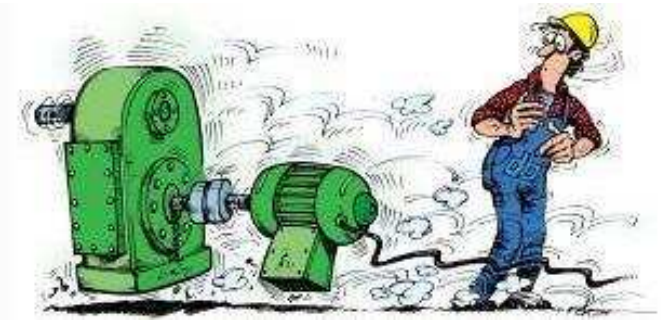
1.1 Methodology.

1.2 What is vibration?

Vibration is a mechanical oscillation around a reference position. It is the variation, usually with time, of the magnitude of a quantity with respect to a specific reference when said magnitude becomes alternately larger and smaller than the reference.

Vibration is the result of dynamic forces in machines or structures that have moving parts or subjected to variable actions. Different parts of the machine will vibrate at different frequencies and amplitudes. Vibration can cause discomfort and fatigue.

A body is said to vibrate when it describes an oscillating movement about a reference position. The number of times a complete cycle of motion occurs during the period of one second is called Frequency and is measured in hertz (Hz). (Midebien, 2020)

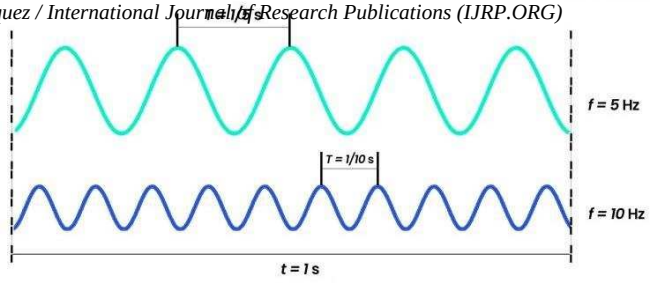


Picture 1(a)vibration (htt1)

1.2 Vibration signals

Vibration signals in practice usually consist of many frequencies occurring simultaneously, so we cannot immediately see by simply looking at the amplitude time pattern how many components there are and at what frequencies they occur.

These components can be revealed by plotting the amplitude of the vibration against the frequency. The decomposition of vibration signals into individual frequency components is called frequency analysis, a technique that can be considered the cornerstone of vibration diagnostic measurements. The graph showing the level of vibration versus frequency is called a frequency spectrogram. When machine vibrations are analyzed, we typically find a number of prominent periodic frequency components that are directly related to the fundamental motions of various machine parts. With frequency analysis, therefore, we are able to trace the source of undesirable vibration. (Midebien, 2020)

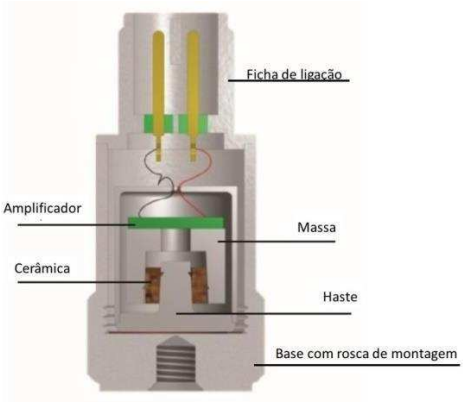


Picture 2(b) signals (htt2)

1.3 What is an accelerometer?

It is a device that provides the ability to measure and analyze linear and angular acceleration. This feature is required in many basic devices and systems used in almost all areas of life, both in everyday home devices and in industrial or professional research and development applications.

Accelerometers are used in measurements of static gravitational acceleration, allowing you to determine the angle of deviation of the measured object from the vertical, as well as in measurements of dynamic acceleration due to shock, motion, impact or vibration, that is, low vibrations. amplitude and low frequency, reaching several dozen Hz. (Electronic Components, 2023)



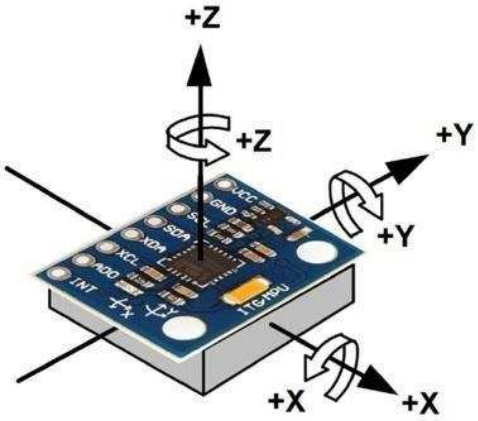
Picture 3(c) accelerometer (DMC)

1.4 MPU 6050

This module is based on the MPU6050 sensor and contains everything necessary to measure movement in 6 degrees of freedom, combining a 3-axis gyroscope and a 3-axis accelerometer on the same chip. It integrates a DMP (Digital Motion Processor) capable of performing complex 9-axis motion capture algorithms.

It communicates through an I2C interface and has a widely used library for immediate use. This sensor can deliver 6 degrees of freedom and incorporates a 3.3V voltage regulator and pull-up resistors for direct use via I2C. For use with Arduino, the i2cdevlib library is used. Its connection is simple through its I2C master interface, thus allowing the control of additional external sensors such as magnetometers or barometers, among others, without intervention from the main processor (saving resources).

For accurate capture of fast and slow motion, it has a programmable scale range of 250/500/1000/2000 degrees/sec for the gyroscope and 2g/4g/8g/16g for the accelerometer. (Naylamp Mechatronics SAC, 2023)

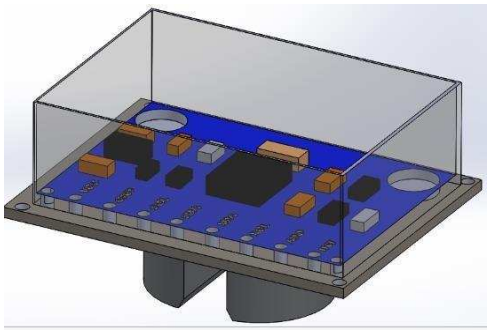


Picture 4(d) mpu6050 (Naylamp Mechatronics SAC, 2023)

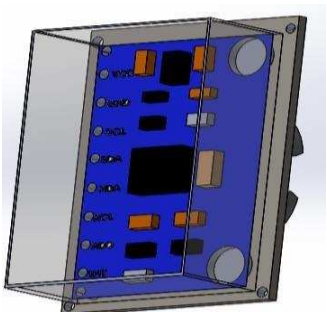
1.4 Triaxial vibration meter

Based on the principle of operation of an accelerometer, it was concluded that; Using an MPU 6050 accelerometer and gyroscope, a device could be made that would perform the main measurement functions of a professional equipment on the general market.

A prototype design was made which has suggested measurements ideal for its application (4cm/3cm/4.5cm).



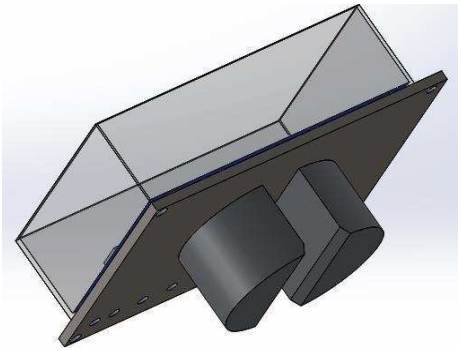
Picture 5(e) Triaxial vibration meter (Own, 2023)



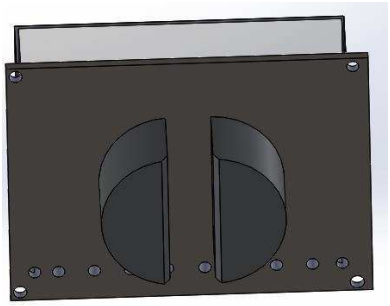
Picture 6(f) Triaxial vibration meter (Own, 2023)

A preferably metallic base is contemplated which will have the mpu 6050 plate attached, this plate has an approximate thickness of 3 or 4 millimeters, this in order to guarantee the resistance and durability of the finished device.

At the bottom of the device, a round magnet with a rough cut was placed, the function of which is to better fix it to the metal part of the motor where it will be placed.

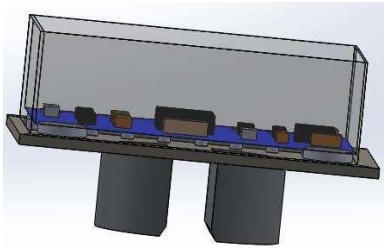


Picture 7(g) bottom (Own, 2023)

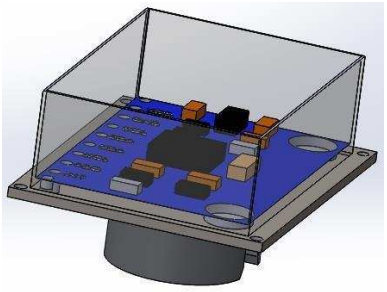


Picture 8(h) bottom (Own, 2023)

A plastic protection was placed on the upper part which will have the function of protecting the mpu 6050 board from any liquid spill or any other circumstance that puts the device in general at risk..



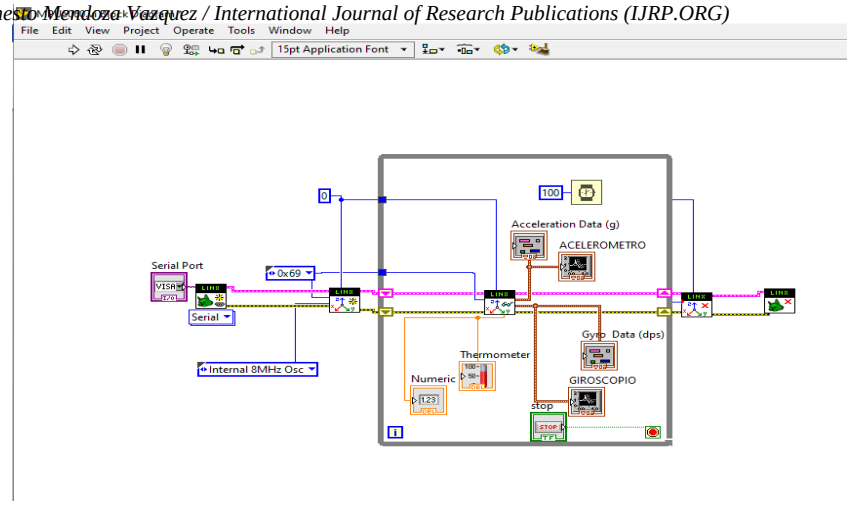
Picture 9(i) Triaxial vibration meter (Own, 2023)



Picture 10(j) Triaxial vibration meter (Own, 2023)

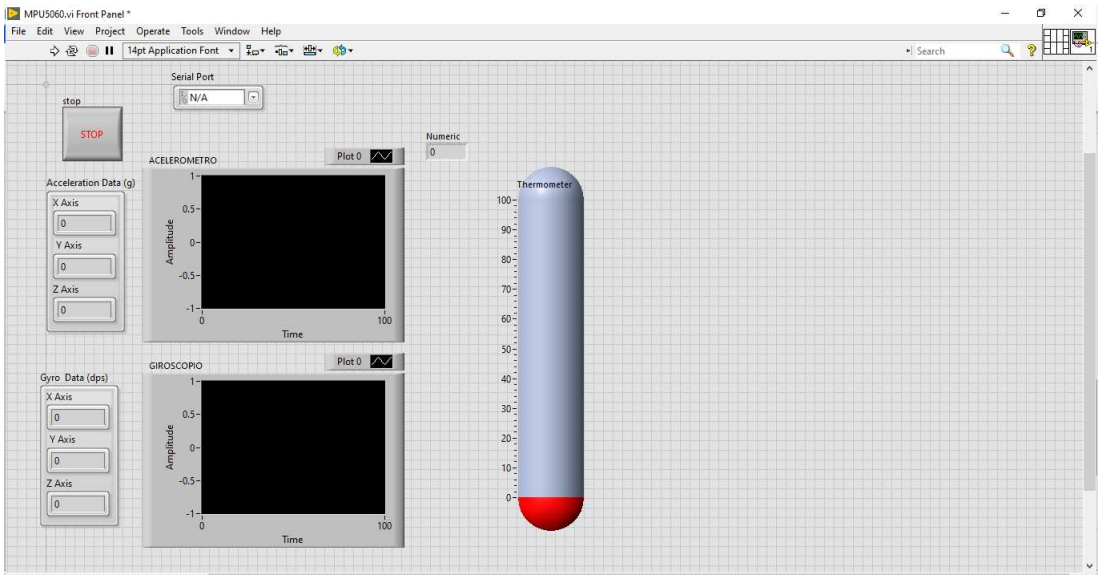
1.5 Programming

Using LabVIEW software, programming was carried out that uses tools such as: controllers, indicators, etc. for controlling the mpu 6050 board.Using this software we were able to control the board more accurately and easily, as shown in the block diagram:



Picture 11(k) block diagram (Own, 2023)

The values returned by the board can be seen in the control panel part of the same software in which a graph was placed showing the measurement written by the accelerometer and the gyroscope since the mpu 6050 board has these two options per factory design.



Picture 12(l) control panel (Own, 2023)

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