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DATA PROCESSING FOR DATA ACQUISITION SYSTEMS: ANALYSIS OF VIBRATIONS IN STRUCTURES

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ABSTRACT

Currently, there is a lot of work and material about vibration analysis for preventive maintenance in machines, but the application of this detection in other areas is almost nonexistent, an example of field that has much to take advantage of this type of analysis, is civil engineering and material analysis. The proposed software uses the hardware system based on the ATMEGA 2560 and ADXL341 to capture the data, and then uses them to detect the frequencies pertinent to the process, showing the results in an interface for the common user. This makes it relevant not only during the construction process, to avoid possible failures caused by the use of heavy machinery, but also allows the monitoring of structures in use, such as bridges, which, over time, may show cracks in their extension.

***Keywords*:** Matlab, processing, IHM, vibrations.

INTRODUCTION

With the cost reduction of microcontrolled platforms and the integration of their programming and interfaces, these systems are being increasingly used for the measurement of physical quantities. In some situations, there is a deficiency in processing capacity; however, the size of such systems is perfect for use in real-time data acquisition systems.

There is a notable concern from hardware system developers regarding data acquisition. On the other hand, the creation of a high level interface that facilitates the understanding of the user is left aside, thus paving the way for such development. This work have as objective the creation of a software for capturing and processing the data of an acquisition system, whose unique proposal is to analyze real-time vibrations in structures with an accelerometer and perform the actions already described, as well as presenting the results at a high level for the user.

The ADXL345 triaxial accelerometer [1] and the chip ATMEGA 2560 form the hardware of the acquisition system used in the present work. The vibrations printed on the three spatial axes of the accelerometer were recorded, in matrix form, by a software wrote in Processing and the mathematical analyzes were performed by a software wrote in MATLAB. This set cooperatively executed the Fast Fourier Transform of the registered time signal and returned to the user periodic graphical responses, facilitating the interpretation of the results.

EXPERIMENTAL AND COMPUTATIONAL PROCEDURE

The algorithm developed is done in two platforms, Matlab and Processing. Initially the data is captured by the program written in the Processing [2] platform, which reads them from the acquisition platform through the serial port (RS-232 model), emulated in a USB port, at a transmission speed of 115200bps, 8 bits of data, one bit of start and stop and no parity bit, so there is no verification of the data in this layer; immediately after this reading, the read value is stored, byte by byte, in a text file, which in turn is closed after one minute of data writing and another text file is started immediately afterwards. When the other text file is started, the software written on the Matlab platform detects the initiation of a new write and starts to process the file that was previously generated, applying a check on the data, indicating possible treatable failures - rows without all columns, rows with extra columns or non-numeric values, all possible and caused by errors in the serial port transmission. These errors are then treated - the defective line is deleted and a copy of the previous line is made, except in the case of the first line of data, in which case it is simply deleted - and then the Fast Fourier Transform is applied, using the fourth data column to obtain the frequency values correctly, since it contains the time between samples. With these data in hand, six graphs are produced - three for the representation of the values in the time domain in relation to the planes x, y, z of the accelerometer and three for the representation of the values in the frequency domain also in relation to the planes x, y, z of the accelerometer - these are then exported as figures to a separate folder and the corrected variables of the text files are then exported in .mat to a folder reserved for them, finally the text file containing the original data is discarded.

RESULTS AND DISCUSSION

Preliminary results show the efficiency in the capture and analysis of the consistency of the obtained data, generating a temporal and spectral graphic of the signal, as well as executing the storing in regular intervals of one minute. In addition, the system identifies the fundamental frequencies of the vibration signals obtained, classifying them according to the standard SN 640312, thus generating alerts, when appropriate, and continuous reports of what is captured.

In addition to the use in detection of structures, where the maximum frequency of analysis is inferior to 300Hz, the algorithm was used for analysis of vibrations in machines, using a smaller data collection interval, but arriving at a maximum analyzed frequency of approximately 1 kHz.

The development of this platform completely in Java has already begun, thus allowing the use in any computer, depending only on the previous installation of the JVM, much more accessible than the software used in the current development.

The integration of the computer platform with the hardware system presented excellent performance and the high storage capacity of the computers allows the data to be collected for long periods without significant losses, thus providing a light system, both for the microcontrolled platform and the computer, which can perform the task in the background without any hassles. The program is already being written in Java, where the same functionalities will be offered, but with a data collection period of less than one minute.

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