Comparative Study of Different Materials on A Drilling Machine with Vibation Signals

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Abstract - It is natural for a machine to vibrate. Nowadays, machines used everywhere in the industry. These Machine tool structures, Drilling machines are subjected to regular unwanted vibrations or chatter. By Using the specific way, the vibration data can be collected, the data can be very useful to control the behavior of the machines. This thesis present the way of collecting the vibration signals for different materials by using specific software and device. The Visual Basic (VB) based programme is used to develop the interface and to obtain the data acquired between computer and the drilling machine by using piezoelectric sensors. The data produces while drilling operation is shown in Time- Amplitude domain. And finally a comparative study of vibration signals between different materials has been made in this study.

Keywords: Vibration signal, Drilling, piezoelectric sensor etc.

I. INTRODUCTION

Vibration is simply the back-and-forth movement of machines or machine components. Any component that moves back and forth or oscillates is Vibrating machine. Vibration can take various forms. A machine component may vibrate over large or small distance, quickly or slowly, and with or without perceptible sound or heat. Machine vibration can often be intentionally designed. At other time machine vibration can be unintended and lead to machine damage. Not all kind of machine vibration is undesirable. For example, conveyors, surface finisher and Compactors are often used in the industry.

Some of the most common machinery problems that cause vibration include:
1. Misalignment of couplings, bearings and gears
2. Unbalance of rotating components
3. Looseness
4. Deterioration of rolling-element bearings
5. Gear wear
6. Rubbing
7. Aerodynamic/hydraulic problems in fans, blowers and pumps
8. Electrical problems (unbalance magnetic forces) in motors
9. Resonance
10. Eccentricity of rotating components such as "V" belt pulleys or gears.

Vibrations occur in a drilling machine because there are forces applied onto structures and machines. In drills for deep hole machining, chatter vibration tends to occur because their bending stiffness and viscous damping are markedly lower than with the other cutting tools. Chatter vibration not only causes a reduction of tool life and machined hole accuracy but also prevents faster and more efficient drilling operations. Vibration signals obtained from machining processes contain very useful information and offer excellent possibilities for the analysis. Therefore, the vibration analysis is carried out on a conventional drilling machine.

C. sanjay [1] performed the Drill Wear Monitoring by Vibration Signature Analysis and made an attempt to identify suitable Parameters, the monitoring of which will enable prediction Of drill failure. M. Ubartas et.al. [2] Have done research on Experimental investigation of vibrational drilling and tried to maximize the degree of reduction of surface roughness as well as axial cutting force and torque. M. S. H. Bhuiyan et. al. [3] have done attempts experimentally to develop a more promising tool condition monitoring system using the acoustic emission and vibration phenomena. Krishna Mohana Rao. G et. al. [4] conducted an Experimental Analysis of Passive Damping Technique on Conventional Radial Drilling Machine Tool Bed using Composite Materials and gave some useful results for the comparative study of vibration signals with and without the use of layer of composite materials below the mild steel specimen. Sharad Kumar Shukla et. al. [5] analyzed the vibration on radial drilling machine using piezoelectric sensor and gave some experimental results for the comparative study of vibration signals for different sites of a radial drilling machine.

The aim of the present work is to record the vibration signals for all three different materials with two different drill bits. Also analyze these signals and make a comparative study between all materials on the basis of vibration signals obtained during the drilling operation.

II. EXPERIMENTAL SETUP

For the experimental purpose the Drilling operation is performed on three different types of materials (Wood, Aluminium and Mild steel). The drilling operation is performed by using two different types of drill bit (5mm and 7.5mm).The other working parameters are shown below in Table 1.

S.No.	Materials	Depth of cut	Drill bit diameter	Speed	Feed rate
1.	Wood	5 mm	5mm and 7.5 mm	260 rpm	0.0256 mm/rev.
2	Aluminium	5 mm	5mm and 7.5 mm	260 rpm	0.0256 mm/rev
3.	Mild steel	5 mm	5mm and 7.5 mm	260 rpm	0.0256 mm/rev

Table 1

Before recording the vibration signals, we need to attach a piezoelectric sensor that can detect vibration behavior of a body that is being measured. In the present analysis the sensor is attached directly on the work piece. Various types of vibration sensors are available, but a type called piezoelectric sensor is used in the research work as it offers advantages over other sensors. The sensor passes the received signal to the Analog to digital converter (ADC Converter) which is followed by the Microcontroller and finally the output data can be obtained on a LCD display simultaneously a graph between Time Vs Amplitude can be obtained on the system.

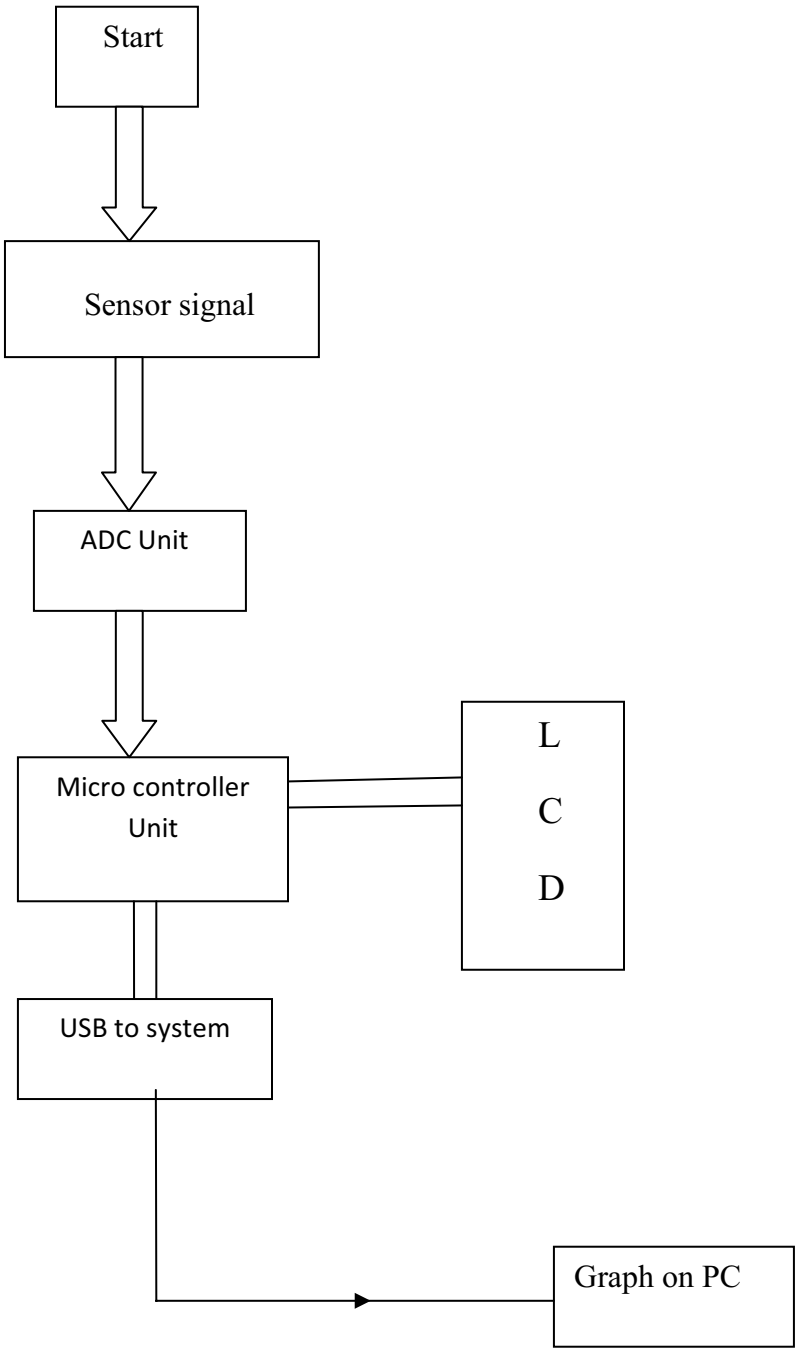

Figure (a) Experimental Setup Diagram

III. RESULT AND DISCUSSION

The comparative chart for all materials for 5 mm and 7.5 mm drill bit is shown in Chart (a) and (b) respectively.

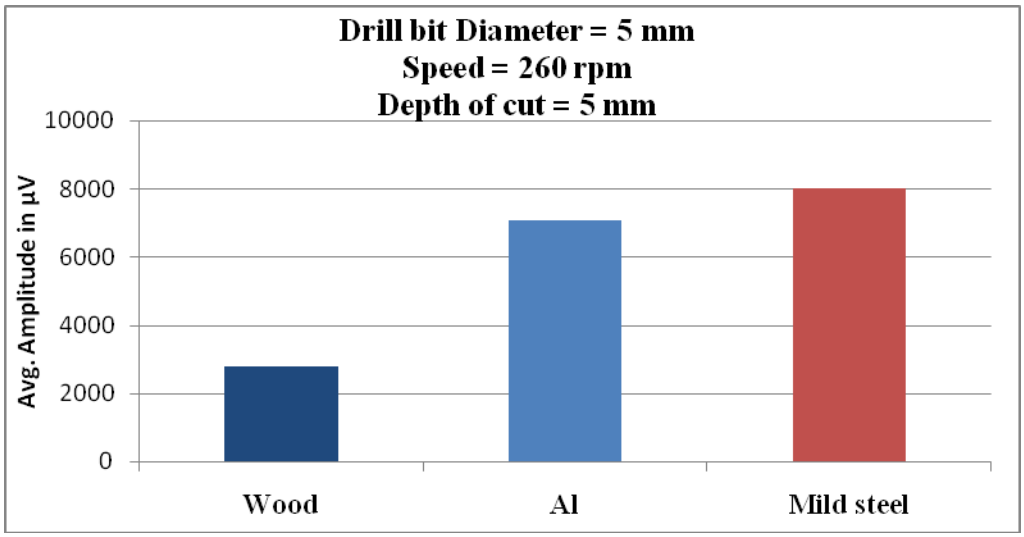

Chart (a) Comparative chart for Wood, Aluminium and Mild steel

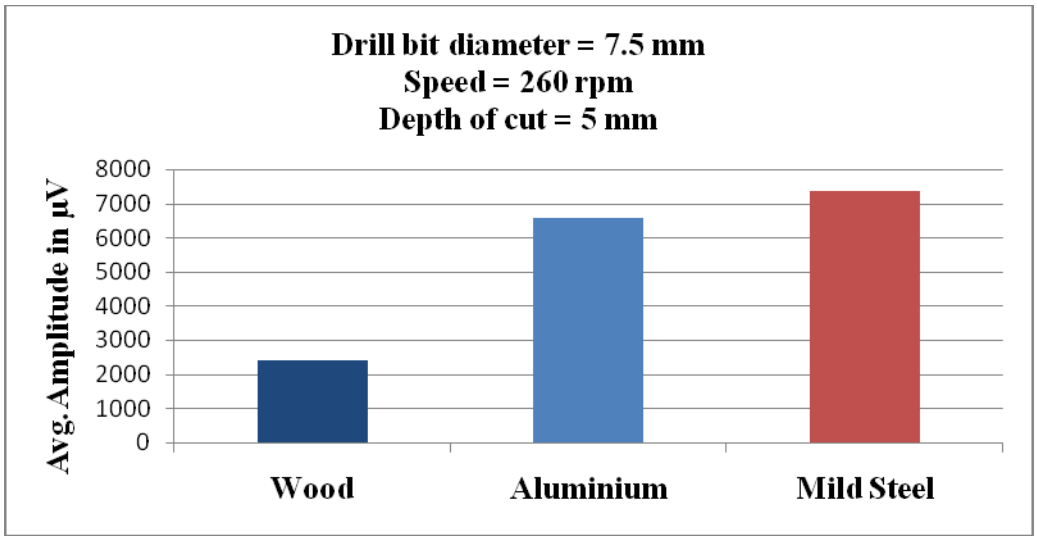

Chart (b) Comparative chart for Wood, Aluminium and Mild steel

We have done vibration amplitude analysis on three different types of materials on a bench drill by using piezoelectric sensor. The materials used in this analysis are Mild steel, Aluminium and Wood. For each material we have taken three trials for the analysis of the vibration Signals. The average amplitude of vibration for all the materials using 5 mm and 7.5 mm drill diameter respectively are shown in Chart (a) and (b) respectively. From the Chart (a) it is clear that the average magnitude of vibration in three trials of wood using 5 mm drill diameter is 2833.33µV whereas the average amplitude of vibration of Aluminium using 5 mm drill diameter is 7066.66µV and finally the average amplitude of Mild steel using 5 mm drill diameter is 8000µV. Similarly from Chart (b) average magnitude of vibration in three trials of wood using 7.5 mm drill diameter is 2400µV, whereas the average amplitude of Aluminium using 7.5 mm drill diameter is 6566.66µV and finally the average amplitude of Mild steel using 7.5 mm drill diameter is 7366.66µV.

IV. CONCLUSION

This study aimed to apply a new technique to understand the vibration characteristics of different materials in drilling process using a low cost piezoelectric sensor. The VISUAL BASIC (VB) based graph on three different types of materials (Wood, Aluminium, Mild steel) shows the amplitude of vibration (in μV). Three trials were made for each material at the same feed rate, speed and depth of cut but using two different drill bits of diameter 5 mm and 7.5 mm respectively. The study reveals that the intensity of vibration varies from material to material. The intensity of vibration is maximum for mild steel, medium for Aluminium and minimum for wood. At last on the basis of analysis we conclude that as wood itself is a soft and shock resistant material therefore vibration is minimum for wood and maximum for mild steel. In other words it can be said that vibration amplitude follows the order of hardness of material as Mild steel is more harder than Aluminium and Aluminium is more harder than wood.

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