Project Proposal Guide & Sample

Disclaimer:

The sample proposal below is to give an idea of how a project proposal should be prepared.

Note that this proposal is not representative of the level of complexity/innovativeness of a winning project.

Name of Project: Development of Add-On Active Vibration Control (AVC) for Power Tools

Project Proposal

1. Abstract

Provide brief description of the project in one paragraph, which states the problem, project implementation approach, expected results, and conclusion.

The aim of this project is to reduce the vibration of power tool by 50% using active vibration control (AVC) system. In this system, an accelerometer will be used to capture the vibration signal. The vibration signal will be processed by NI myRIO-1900 controller and an activation signal will be sent to an amplifier to drive the piezo actuator to counteract the vibration of the beam. Both simulation and experimental work will be done. ANSYS simulation will be done on a cantilever beam to predict the characteristic of the piezo actuator. The control algorithm will be developed in LabVIEW and once it is verified, it will be uploaded to NI myRIO-1900 and further testing of the AVC system on a vibrating cantilever beam will be done. The final phase of the project is the application of the system on an actual power tool.

2. Project Introduction

Introduce the project background, problem statement that indicates the importance of the project, the scope of the project, and the objectives of the project.

Provide an overall structure of the project.

Include a description of how and why you use the platform to implement the project.

Define the expected performance specifications of your design.

Hand-Arm Vibration Syndrome (HAVS) is a widespread hazard in many industries and occupations involving the use of handheld power tools or hand-fed machines. In the industry, power tool is one of the common tools that have been used by the worker in almost every day [1]. The vibration induced by the electrical tools can be enough to cause physical discomfort, reduced performance or even cause illness such as HAVS. This also include decrease of grip strength [2].

Department of Occupational Safety and Health (DoSH) Malaysia has released Guidelines on Occupational Vibration in 2003, which included the threshold limit values (TLV) for vibrations transmitted to hand-arm [3]. The effect of vibration on workers have also been researched in Malaysia

[4, 5]. Power tools are widely used in industry and in construction. The use of power tools can cause HAVS which include tingling and numbness.

Based on the statistics completed by Health and Safety Executive in United Kingdom, there were 8,990 individuals reported to have picked up HAVS during the duration of 10 years between years 2003 to 2012. In year 2012 alone, the number of new cases of HAVS assessed for disablement benefit was 635 [6].

ANSYS simulation will be done on a cantilever beam to predict the characteristic of the piezo actuator. The control algorithm will be developed in LabVIEW and once it is verified, it will be uploaded to NI myRIO-1900 and further testing of the AVC system on a vibrating cantilever beam will be done. An accelerometer will be used to capture the vibration signal. The vibration signal will be processed by NI myRIO-1900 controller and an activation signal will be sent to an amplifier to drive the piezo actuator to counteract the vibration of the beam. The final phase of the project is the application of the system on an actual power tool. The whole flow is illustrated in Fig. 1.

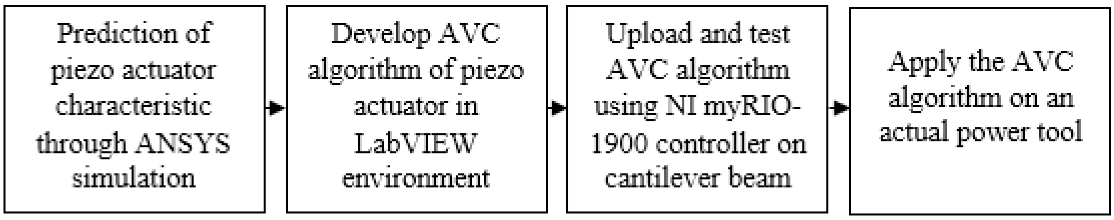

Fig. 1 Overall flow of AVC project

The objective of this study is to develop an active vibration control that can be applied to power tools to reduce 50% of vibration transmitted to the operator's hand.

3. Design Methodology

Explain the project implementation methodology, techniques and tools used, and the flow of the project.

3.1 Characterize the piezo patch actuator

Although piezo patch actuators can be characterized by the linear piezoelectric theory and linear piezoelectric constitutive equations (LPCE) can be derived based on thermodynamic principles (Chee et al 1998) [7], Ehlers and Weisshaar (1990) [8] proposed that nonlinear piezoelectric effects will become significant in applications involving high electric fields and cyclic fields resulting in hysteresis. Therefore, it is important to determine the characteristics of the piezo patch actuators using simulation software such as ANSYS to determine the feasibility of piezo patch actuators in damping the vibration of power tools.

A simple beam will be modelled in ANSYS with piezo patch actuator bonded to it and the active vibration control in the actuator will be simulated. By inputting different values to the parameters in ANSYS, the damping characteristics of the piezo patch actuators can be obtained.

3.2 Phase 1: Design of the control algorithm in LabVIEW

An algorithm will be designed using LabVIEW Graphical Programming to perform a closed-loop active vibration control on a simple beam. The algorithm will be based on linear quadratic (LQ) control which attempts to minimize the overall control energy, indicated by a cost function given in a quadratic form. When multiplied by the state, the resulting feedback matrix yields an input which will keep the cost function at its minimum [9].

3.3 Phase 2: Proof of concept using LabVIEW

A simple beam will be fabricated according to the model used in ANSYS, with suitable fixture to hold it in place. The piezo patch actuator will be bonded to the beam and an accelerometer will be attached to the beam to measure the vibration acceleration of the beam. An unbalanced mass motor will be used to give a constant forced vibration to the beam. The accelerometer will pick up the acceleration readings, and a NI cDAQ-9174 with NI 9234 module will capture the readings from the signal generated from the accelerometer. Using LabVIEW, graph of amplitudes of the signal will be plotted in time domain. Fast Fourier Transform (FFT) will be used to plot the signal in frequency domain. The algorithm programmed in LabVIEW will then produce the inverse of the measured signal. The signal produced from the algorithm will then be sent by the NI 9263 module, which is then amplified by an amplifier by Physik Instrumente (PI). The amplified signal will act as the input for the piezo patch actuator, which will damp the vibration of the beam. Fig. 2 shows the Phase 2 block diagram of the AVC system. The active vibration control system is thus formed. The significance of the damping effect will be measured and compared with the model in ANSYS. Fig. 3 shows the Phase 2 experiment set up to validate the ANSYS model. Fig. 4 (a) and (b) shows the expected response of the vibration of the beam with and without AVC system [10]. Fig. 5 shows the expected response of the vibration of the simple beam with active and passive control [9].

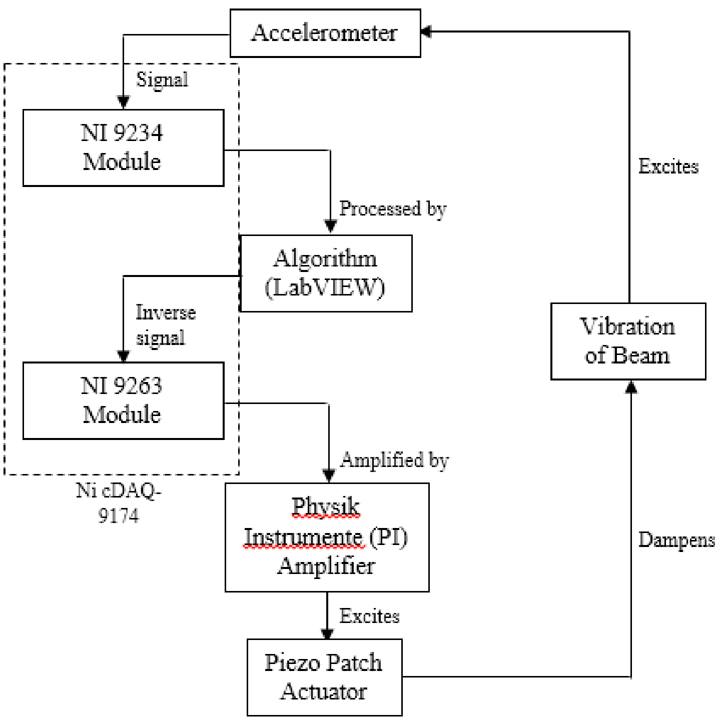

Fig. 2 Phase 2 flow chart for AVC system of a cantilevered beam

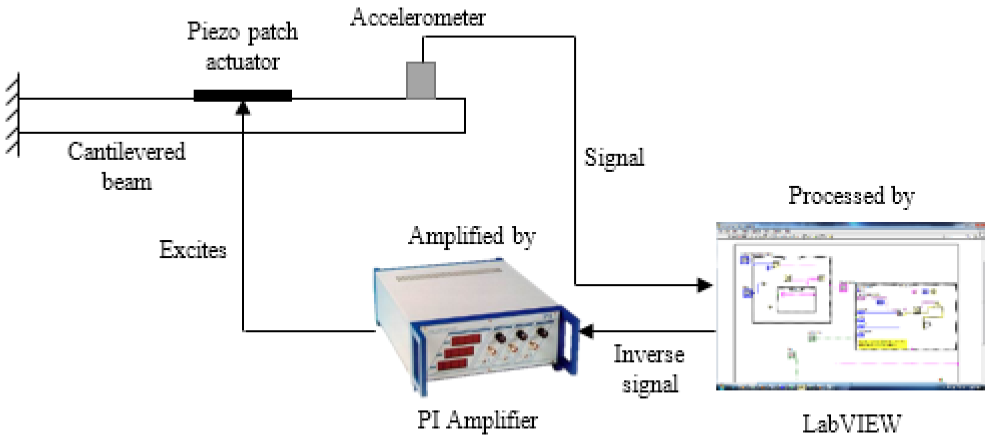

Fig. 3 Phase 2 experiment set up for validation of ANSYS model

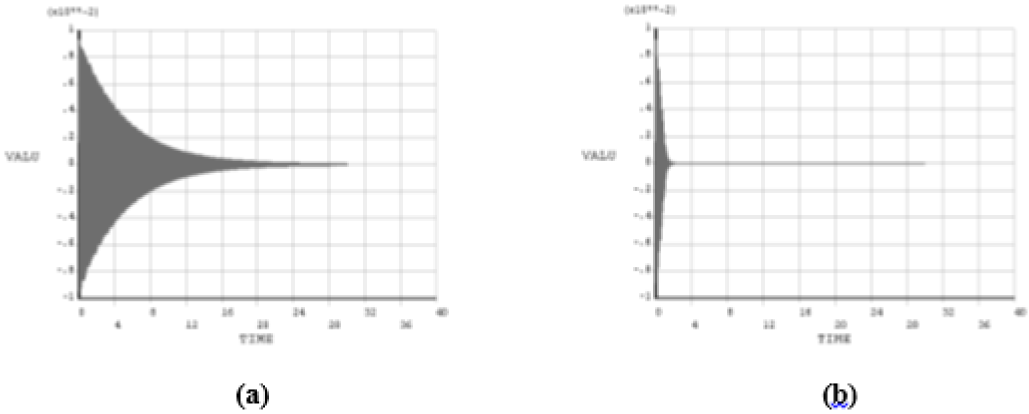

Fig. 4 Expected response of the vibration of the beam with (a) open-loop system and (b) closed-loop control system

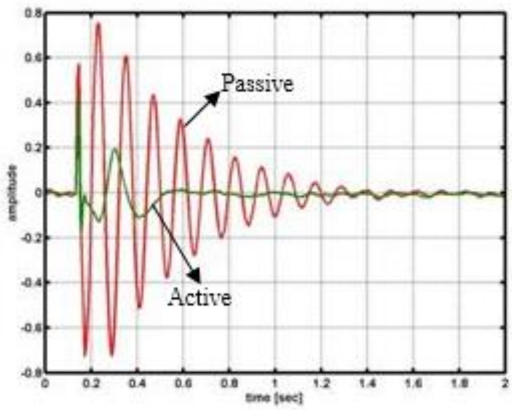

Fig. 5 Expected response of the vibration of the simple beam with active and passive control

3.4 Phase 3: Proof of concept using NI myRIO-1900

Once the algorithm is proven to be working, the AVC system will be modified by having the NI myRIO-1900 as the controller. The algorithm programmed in LabVIEW will be uploaded to NI myRIO-1900.

The experiment stated in Section 3.3 will be repeated and both results will be compared. Fig. 6 shows the Phase 3 flow chart of the AVC system. Fig. 7 shows the Phase 3 experiment set up to validate the ANSYS model.

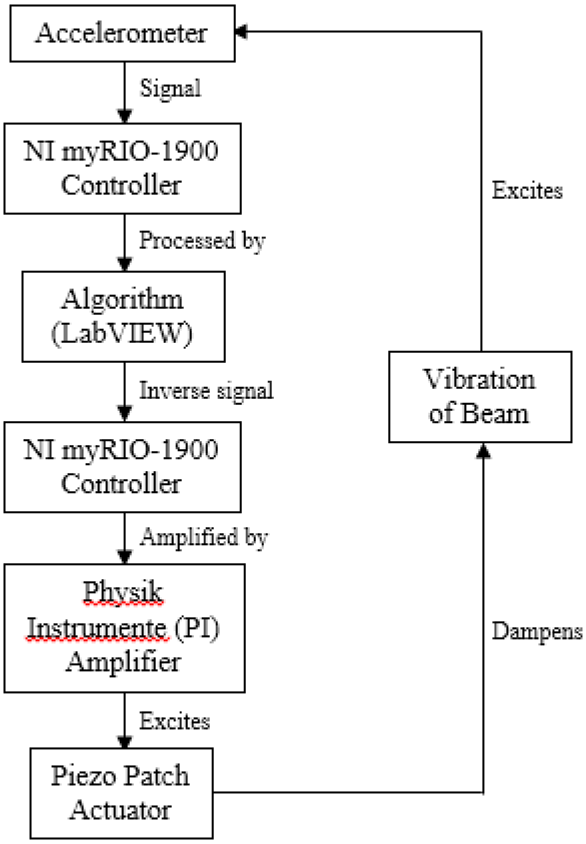

Fig. 6 Phase 3 flow chart for AVC system of a cantilevered beam

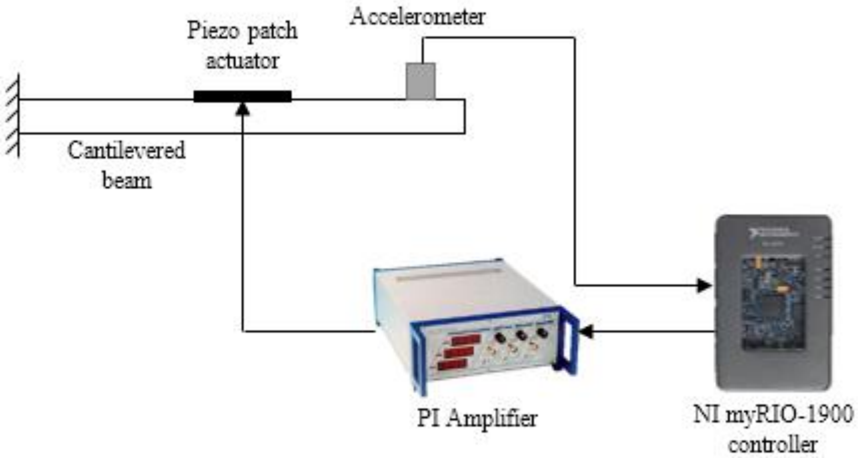

Fig. 7 Phase 3 experiment set up for validation of ANSYS model

3.5 Identify handle vibration of power tools

A power tool will be selected to determine the practical feasibility of using piezo patch actuator as active vibration control device. The sources and paths within the electrical appliance that contribute to the overall vibration problem issue will be determined and the dynamic characteristic of the electrical appliance will be understood. This can be done by using frequency analysis, experimental modal analysis and Operational Deflection Shape (ODS) test.

3.6 Improvement of system

The first attempt may not produce the results we desire. Analysis will be made to identify areas of improvement to further reduce the vibration to a lower level. This also include identification of the tool dynamics and better matching of the active vibration control characteristics.

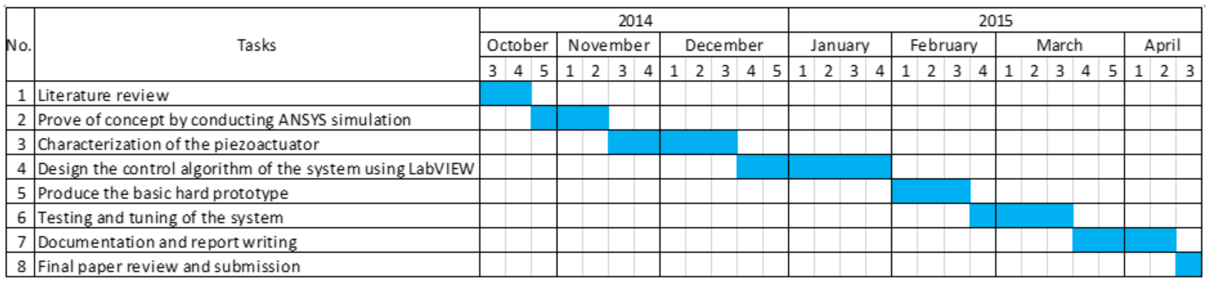

Fig. 8 Gantt chart of project

References

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