Design And Implementation of Vibration Detector For Motor Vibration Test

U. Danusha[1], P.Hema[2], P.Menaga[3], J. Nanthini[4], Dr.A.SenthilKumar[5]
[1, 2, 3, 4] Dept of Electrical and Electronics Engineering
[5]HOD, Dept of Electrical and Electronics Engineering
[1, 2, 3, 4, 5] Dr.Mahalingam College of Engineering and Technology, Pollachi, Tamil Nadu, India.

Abstract- *Vibrationisolation and reduction techniques have become an integral part of machine design, the need for accurate measurement and analysis of mechanical vibration has grown. This need was largely satisfied, for the slow and robust machines of yesteryear, by the experienced ear and touch of the plant engineer. Every motor in the production unit is passed through the vibration test which is done manually. During testing phase the human error has been increased. In order to reduce this error, this paper presents a vibration detector for vibration test of universal motor in mixer grinder. The vibration is sensed using vibration sensor in the form of velocity (mm/s). The velocity range for universal motor is given as a range of conditions to the controller. During the testing phase, if the vibration frequency is not within the limits then the motor is indicated as rejected or vice versa. Using the above technique, the human errors are reduced and so the rework and its cost are ignored. The analysis of the vibration of a motor using the vibration detector module is presented. The efficiency of the test conducted by human is 60%. The 40% of the failure can be avoided by using the vibration detector module.*

Keywords- Controller,Universal motor, Velocity, Vibration frequency and Vibration isolation.

I. INTRODUCTION

Recent years have seen the rise of vibration problems associated with structure, which are more delicate and intricate, and machines which are faster and more complex. The problems have been coupled with demands for lower running costs and increased efficiency. Concern has also arisen about the effects of noise and vibration on people and on the working lifetime of manufactured items. Consequently, there has been a requirement for a greater understanding of the causes of vibration and the dynamic response of structure to vibratory forces. To gain such an understanding an accurate, reliable and versatile vibration transducer is required.

Vibration problems can occur at any time in the installation or operation of a motor. When they occur it is normally critical that one reacts quickly to solve the problem. If not solved quickly, one could either expect long term damage to the motor or immediate failure, which would result in immediate loss of production. The loss of production is oftentimes the most critical concern.

The vibrations of a system can be expressed as a displacement or as a velocity or as acceleration. Electrical and mechanical source of vibration are at different frequency and phase angle and/or one type of vibration may modulate the other type of vibration and result a vibration with variable amplitude and phase. By detecting vibratory acceleration we are not tied to that parameter alone, with electronic integrators we can convert the acceleration signal to velocity and displacement.

Most modern vibration meters are equipped to measure all three parameters. Where a single, wide frequency band vibration measurement is made, the choice of parameter is important if the signal has components at many frequencies. In this paper the various sources of electrical and mechanical forces will be explained. Additionally, how the motor vibrations can be detected will be explained as well. When a vibration problem occurs it is important that one use a good systematic, analytical approach in resolving the problem.

II. SOURCES OF VIBRATION IN MOTOR

A. MOTOR BASE VIBRATIONS

The standards prescribe a rigid base for electric motors which means the vibration near to the motor feet must be less than 30% of the vibration measured at the motor bearing. If the motor base is weak results a vibration in horizontal direction. The frequency of this vibration is double line frequency or double rotational frequency. To identify the type of the vibration this must be measured in both directions, horizontal and vertical too. The horizontal component of the vibration due the weak base adds to the motor self-vibration, resulting in a total vibration. This can be observed at the bearings too.

B. BEARING VIBRATIONS

Bearing vibrations are present in all types of rotating systems and motors. Anti-friction bearing are an important part of the motor. The bearing usage influences the whole rotating system. Bearings have the following defect source, inner race, outer race, roller spin and bearing cage. All these introduce identifiable defect frequencies. Because there is no allowed amplitude for these frequencies it should be followed the presence of the defect frequency harmonics.

C. BROKEN ROTOR BAR VIBRATIONS

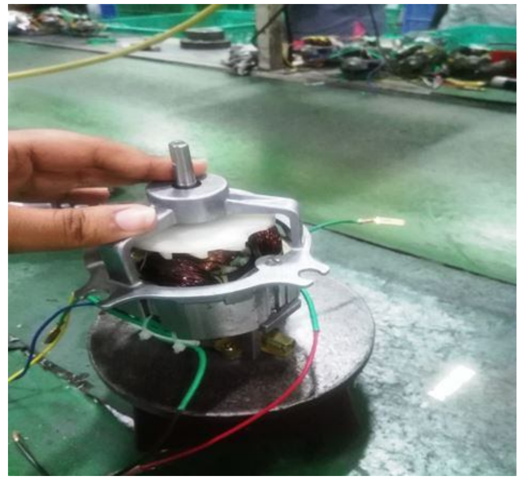
If the rotor bar is broken then this bar will have no current and no magnetic field. This will create a magnetic unbalance between the two opposite side of the motor, side with broken bar and side with unbroken bar. The unbalance creates a magnetic force which rotates with rotational speed and modulates at the frequency equal to the slip frequency times the number of poles. Further this change causes more heating around the rotor; the rotor bows and creates eccentric rotor, then unbalanced and magnetic force. This causes a twice line frequency vibration.

D. MOTOR UNBALANCE

All rotating machinery, motor must be balanced to have an easy, quite operation. The rotor is an important part of motor, his balance influence the whole working of the motor. The rotor is made up of a multitude of parts so all parts must be controlled and manufactured with great concentricity to have a stable balance. The rotor is balanced without fans and with assembled fans. Balance correction should be made at or near the unbalanced points. Any changes in rotor, broken bar, electromagnetic force changing, will influence and change the balance.

III. EXISTING SYSTEM

The vibrations of the universal motor used in mixer grinder are tested by the vibrations felt by the human. The perceptions of humans vary from one person to another. The motor tested by human who is said to have no vibration actually has the vibrations. So we have designed and implemented a vibration detector module which can display the values sensed by the sensor and the indication is given.



(a)

(b)

Figure 1 Testing of motor by human (a) At Top and (b) At Core

IV. PROPOSED SYSTEM

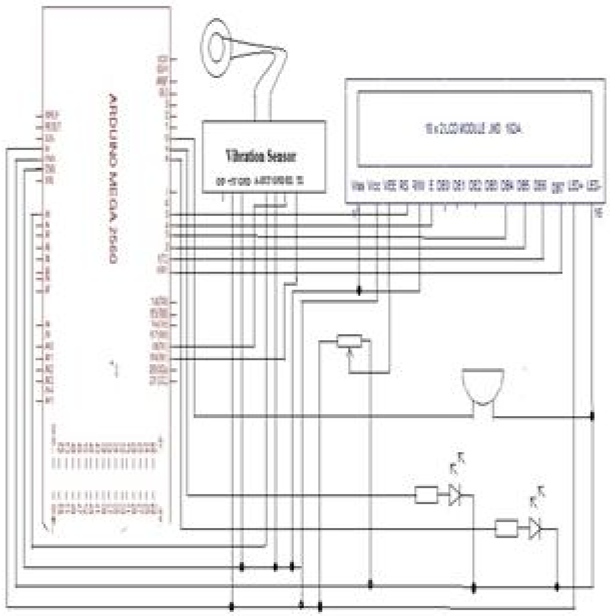


Figure 2 Circuit Diagram of the Vibration Detector

The vibration sensor module consists of six utilizing pins as shown in the figure 2. The transmitter and receiver pins of the module are connected to the receiver and transmitter of the arduino board respectively. All the power pins are connected to theV_{cc} pin of the arduino and whereas the ground pins to the ground pin of the arduino. The range of vibration velocity should be less than or equal to 0.71 mm/s. In order to know that the motor is selected or not, the red indication becomes high if the range is not satisfied hence it indicates that the motor is rejected. If the motor satisfies the given range of velocity then the green indication glows and thus the motor is indicated as the selected motor. The potentiometer has three pins in which the first pin is given the +5v supply and the middle pin is connected to the Enable pin of the display screen which is connected in order to adjust the brightness of the display screen , the last pin of potentiometer is connected to the ground of the arduino. The pin number 5, 6, 7, 8 will be acting as the data transfer pins. The transmitter (Tx) and receiver (Rx) of display screen is connected to the Rx and Tx of the arduino respectively.

V. RESULTS AND DISCUSSION

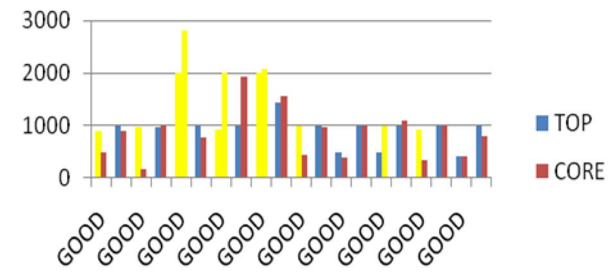


Figure 3 Analysis of Vibration of Motor at Different Portion

From the figure 3, for a universal motor to be at good condition, it needs to pass through various tests. The major test in which the majority of motor fails is “VIBRATION TEST”. The good motor has the standard range of vibration based on ISO IS 2372 specification. The standard range of velocity for universal motor below 15KW should be below 0.71 mm/s. If the above standard range is not met then the motor is considered as the defective motor. The measurement of velocity was taken from the two portion of the motor, namely (i) Top(ii) Core.The motor tested by the human was again tested using the vibration detector and results were plotted. From the figure 3, the yellow color bar represents the motor which was accepted as defect less motor by the human and later was detected as the defective motor by the vibration detector module.

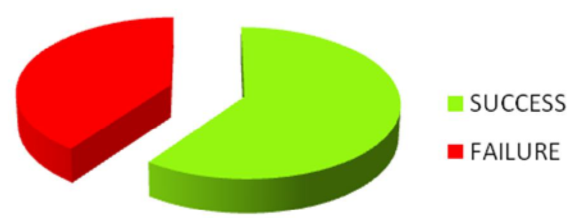
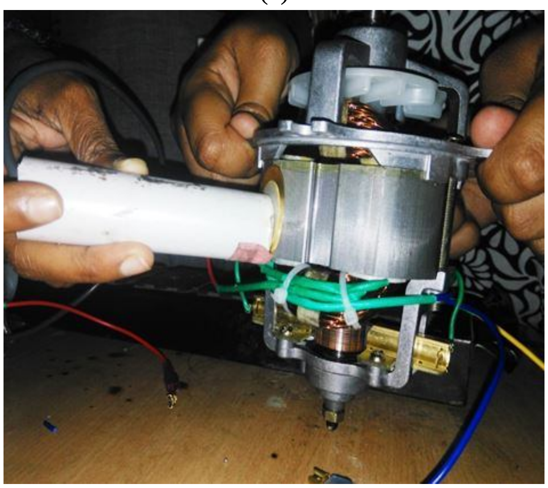


Figure 4Comparison between Human vs Module efficiency

The above chart depicts that 60% of motors tested by the humans are correct and whereas 40% of motors tested by them shows failure rate which occurs due to the human error. This human error can be rectified using the vibration detector.

(a)



(b)

Figure 5Testing of mixer grinder motor (a) At top and (b) At Core

The figure 5shows that the universal motor being tested by the sensor at the top of the motor and at the core of the motor. If the vibrations occur on the either of the top or core the motor is rejected.

APPENDIX

```
#include<SoftwareSerial.h>
#include<LiquidCrystal.h>
LiquidCrystallcd (5,4,3,2,1,0);
SoftwareSerialmySerial(19,18);
int value;
intsen;
intleed=8;
int led=9;
intbuz=10;
charbuf[10];
void setup()
{
        lcd.begin(16, 2);
        pinMode(A0,INPUT);
        pinMode(led,OUTPUT);
        pinMode(leed,OUTPUT);
        pinMode(buz,OUTPUT);
        void loop()
        {
if(mySerial.available())
        sen=mySerial.read();
                lcd.setCursor(0,0);
                value=analogRead(A0);
                int voltage = value * (1000/ 1023.0);
                sprintf(buf,"value=%d",voltage);
                lcd.print(buf);
        if(voltage<=850)
                {
        digitalWrite(led,HIGH);
        digitalWrite(buz,LOW);
        digitalWrite(leed,LOW);
}
                else
                {
        digitalWrite(leed,HIGH);
        digitalWrite(buz,HIGH);
        digitalWrite(led,LOW);
}
delay(2000);
}
```

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