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Digitized Electric Horn Tuning Range Testing System with Automatic Recording

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Abstract: *This project is concerned about checking the Tuning Range of an Electric Horn used in automotives and to display the values in digitized format. The displayed values are interfaced with computer for future advancement. The vibration of the electric horn is used for measuring the tuning range, which decides its life expectancy. The existing system used for measurement is an analog device, which requires frequent calibration and appended labor for documentation. The project involves measuring of tuning range with the help of the Accelerometer. The output from sensor is transmitted to microcontroller, which is interfaced with LCD and UART for display and future enhancement. If the displayed value is in-between tuning range, the work piece can be allowed for dispatch. The appropriate horns are separated using gear motor mechanism. Thus, the proposed system supports the workers at Electric Horn manufacturing industries to increase the productivity. It eliminates the vision problem experienced by workers while measuring analog values.*
Key Word*: Accelerometer, Electric Horn, Tuning Range, UART, Vibration*

I. Introduction

In today's competitive world, Industries are looking for ways to improve their production process. In a typical horn manufacturing Industry, the process involves various stages like designing, procurement of materials, assembling and testing. In this testing is an important stage, where the specifications of the work pieces are cross verified according to the quality standards. According to industrial aspects product testing, also called consumer testing or comparative testing is a process of measuring the property or performance of product. In an electric horn, tuning range is a parameter of major importance to be checked in final evaluation. It decides about life expectancy and the need for replacement. If the range is not maintained between a prescribed limit, the quality standard of the product is majorly affected. Hence in the proposed system, the test process is made more efficient and the whole process time is reduced, so the production rate is increased. Human labor is only used to place the work piece in a proper position and measurement process is automated, hence reducing work force.

II. Objective Of The Project

The objective of the project is to convert the existing Analog measuring instrument used in the final step of assembly line of Horn manufacturing unit into a Digital device, and to check the tuning range using Accelerometer. Measured values should be stored and retained for future use. Overcoming the existing systems disadvantage, the accuracy of the attained values need to be improved. Repeatability of the output is to be achieved, when comparing with the Analog system. Further a model for separating the appropriate horns is developed.

III. Importance Of Tuning Range

An Electric Horn has a diaphragm driven by a plunger which is vibrated by a coil having a pole piece. The small air gap between the plunger and pole piece is required to assure that they will not touch during vibration. This minimum space is called as Tuning Range**.** It is measured in unit mm and it should be in the range of 0.11-0.18. This range varies according to the standards followed by the industry. If the range is very small wear and tear of mechanical parts takes place and if it is very high, the horn requires high current to energize the coil. Hence the range should be maintained properly.

IV. Block Diagram

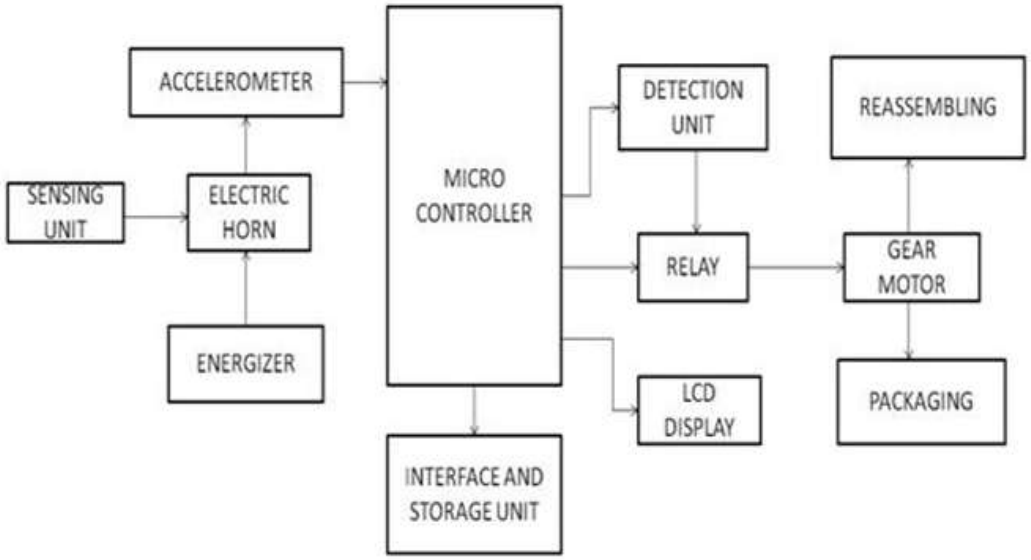

Figure 1 Block Diagram

Block Diagram Description

The various units of proposed model are indicated in Fig.1. The following are the detailed description of the different units.

PIC Micro Controller (16F877A)

The PIC micro controller (16F877A) [1] offer cost efficient solution for general purpose applications written in C that uses a real time operating system and requires a complex communication protocol, stack such as TCP/IP, CAN, USB,I2C bus. The general features of microcontroller are

- It has Watch Dog Timer
- It has Power On Reset
- Single cycle Instruction
- Flash Memory
- Contains both serial and parallel ports
- Very high speed of operation (20 MHz)
- High sink/source current 25 mA

The microcontroller program is done using MPLAB IDE and is interfaced with the micro controller using PIC KIT3

Accelerometer (ADXL335)

Accelerometers (ADXL335) can measure acceleration in one ,two or three orthogonal axes. It operates at single-supply ranging from 1.8 V to 3.6 V. Specifications are 3-axis sensing Small, low profile package 4 mm × 4 mm × 1.45 mm LFCSP Low power:350 µA (typical), 10,000 g shock survival, Excellent temperature stability BW adjustment with a single capacitor per axis RoHS/WEEE lead-free compliant. In this project, ADXL335 is used to sense the vibration from Electric Horn.

Sensing Unit

The unit consists of IR sensor and OP-AMP (IC741). IR Sensor operates at 12 V. The wavelength region of 0.75µm to 3 µm is called near infrared, the region from 3 µm to 6 µm is called mid infrared and the region higher than 6 µm is called far infrared. OP-AMP works as a voltage comparator, when the IR receiver does not receive a signal, the potential at the inverting input goes higher than the non inverting input of the comparator. Thus the output of the comparator goes low. When the IR receiver gets signal, the potential at the inverting input goes low. Hence the output of the comparator goes high when the horn terminals are detected, and the signal is fed to microcontroller for further processing.

Relay (12VDC SPDT)

A relay is an electrically operated switch which uses an electromagnet for mechanical operation. Relays are used where it is necessary to control a circuit by a separate low power signal or where several circuits

must be controlled by one signal. Rated up to 10A, fully Sealed and can be mounted directly into breadboard - 300mil spacing. The output signal from microcontroller after checking the tuning range is used to trigger the relay, which controls the operation of gear motor.

DC Gear Motor (100 RPM)

A gear motor may be an AC or DC motor coupled with a gear box or transmission. A gear motor adds mechanical gears to alter the speed or torque of the motor for an application. Usually such an addition is to reduce speed and increase torque. Most gear motors have an output of between about 1200 to 3600 revolutions per minute (RPMs). The gear motor used in our system has the specification of 12 V, 100 RPM.

Liquid Crystal Display

After the tuning range has been detected, the necessary commands are displayed in LCD. Each character is displayed in 5x7 pixel matrix**.** Command register stores the command instructions given to the LCD.Data register stores the data, to be displayed on the LCD.

UART

The UART performs serial-to-parallel conversions on data received from a peripheral device and parallel-to-serial conversion on data received from the CPU. The CPU can read the UART status at any time. The UART includes control capability and a processor interrupt system that can be tailored to minimize software management of the communications link. The micro controller communicates with computer through UART.

Theory Of Operation

The regulated output voltage from IC7805 is fed into the LM317 voltage regulator. In order to amplify the current given to the horn terminals LM317 is used. The vibration from horn is sensed using three axis accelerometer which sends analog signal to the PIC microcontroller. It is connected to pin 2 of the micro controller. Received signal is an analog signal hence micro controller converts it into digital value in readable format. The PIC micro controller displays the value of tuning range using LCD display. LCD is connected to the PORT B of the PIC. If the value obtained is not within prescribed range, a signal is given to relay. It operates the gear motor connected with tiny shaft that pushes the Horn for separating between reassembling section or packaging section. Finally the value is displayed in the LCD and stored in the PC using UART cable [2].

Circuit Diagram

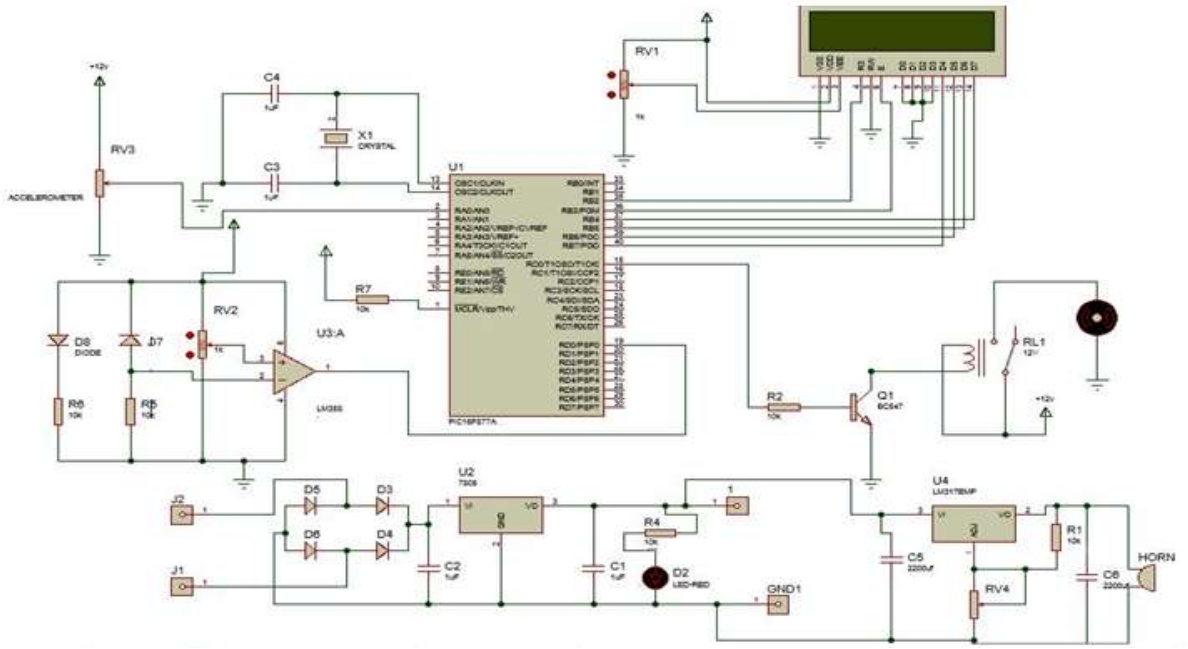

Figure 2 Circuit Diagram

V. Result And Discussion

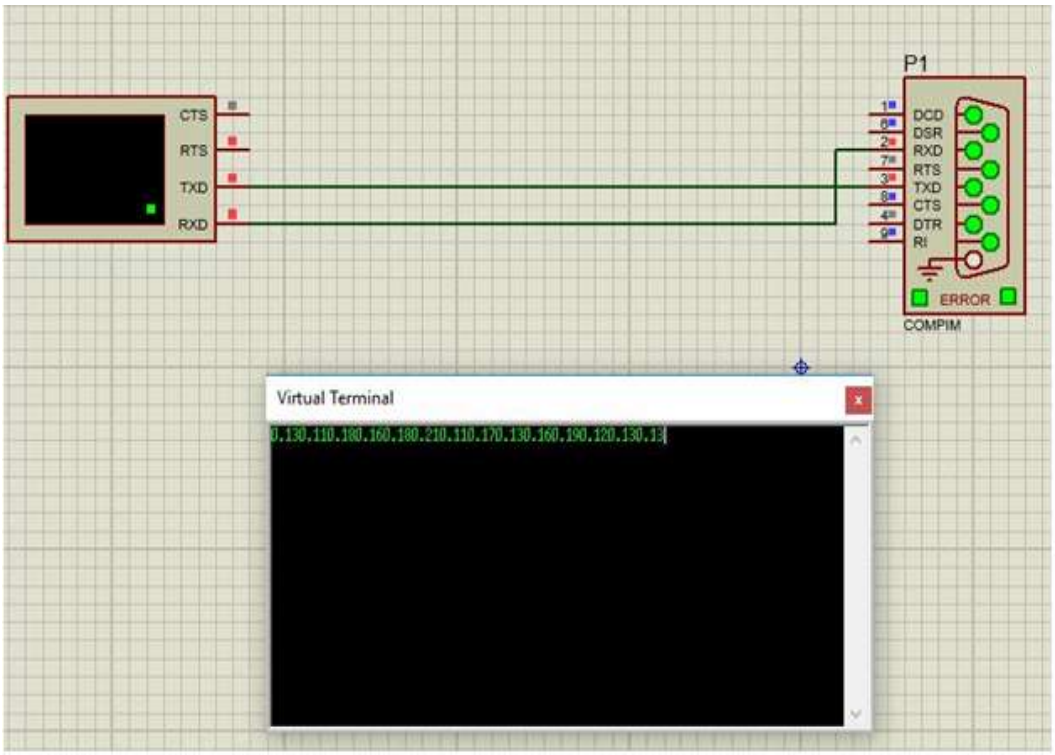

Figure 3 Output

The result shown in Fig.3 displays the values of various horns that is tested in assembly line [3]. From the readings, it can be interfered that the optimal value is achieved during testing and it is further documented for report generation that will be used for inspecting quality standards.

VI. Conclusion

The existing analog device can be replaced by this new project Digitized Tuning Range Checking Device for Electric Horn with Automatic Recording. This improves the production rate and eases the manual work done during testing. The use of accelerometer and microcontroller makes the system efficient and highly accurate. By using the proposed system, the automobile horn manufacturers can reduce the cost of labor and document the results for analysis. This system can be operated large scale horn manufacturing units, thus the time of production can be reduced.

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