

Design and Development of Control System for Torsion Bar Testing Machine using Raspberry pi

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Abstract— Torque is a parameter used to evaluate the amount of bend that a material can tolerate when it is subjected under certain forces. By using the torsion bar testing machine increased elasticity of the bar can be obtained as well as the quality of the manufactured bar is assured. The tanks being manufactured by the factories use torsion bar to drive the wheels. The motive behind our project is to ensure whether the manufactured torsion bar is fit for production of heavy vehicles by determining the torque and angle values using the electronic based testing machine.

Keywords—Torque, Testing machine, Torsion Bar.

I. INTRODUCTION

A torsion bar is mainly a suspension mechanism used in vehicles. These bars are usually metal bars which work as a spring. One end of the bar is connected to the frame of the respective vehicle

whereas the other end is attached to the suspension arm of the vehicle. As a vehicle moves the forces created by the motion of the vehicle create torque on the bar, which twists it along its axis. The heavy vehicles being manufactured by the factories use the torsion bar to drive the wheels.

II. OBJECTIVES

The torsion bars which are manufactured for the heavy vehicles have to withstand certain tensional forces which are acted upon the rod while the tank is on road. So as to ensure that the perfect torsion bars are being provided for further tank manufacturing process, torsion bar testing process is performed. The main objective is to figure out the most suitable torsion bars for the tanks through this testing mechanism.

The selection of the accurate torsion bars are done by determining the values of torque and residual angles by the testing mechanism and comparing it with the industrial standard figures such that it must satisfy industrial values, if does not make it then the bar is defective.

III. EXISITING SYSTEM

The wolpert torsion bar testing machine employs is a based add-on cards compatible with xt-pc to control various types of signals. An add-on-card adds functionality to the system and the torque is measured from load cell. The value corresponding to load is transmitted to pc by sipart controller through serial port via serial communication. The angle is measured by counter. The rotary encoder gives 5000 pulses per revolution. Only positive going pulse is considered for counting.

The output from the counters are buffered and fed to pc through add-on card. From the add-on card, the signals are given to the relay board via ULN2003 and driver to control the motor drive. The software installed in PC scans the add-on card and SIPART DR20 for process variables and it can be viewed on screen for continuous monitoring. Also,

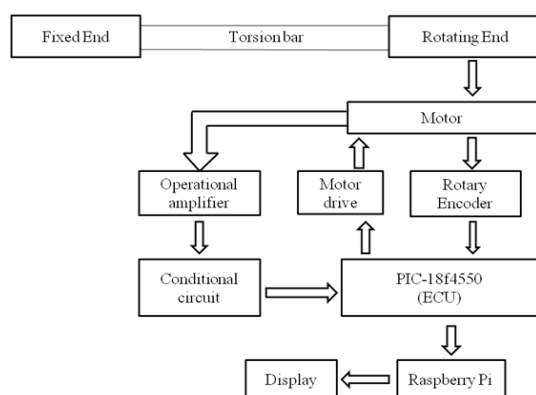
the necessary outputs are provided for controlling the drive of motor to the relay board via a bus driver.

IV. DRAWBACKS IN EXISTING SYSTEM

The existing control circuit for the WOLPERT machine is aggreable combination with the ISA bus of the main computer but ISA bus has become outmoded in current modren world and there are no spares available. WOLPERT torsion testing machine is a German make and the machine may costs around 6 crores now. In case of any problem, failure and breakdown of the machine, there is no support from the machine manufacturer. Also, the existing hardware details and source file for software are not available.

The machine also involves complex circuitry with bulky and more cabling, making maintenance and repair difficult. The machine also uses old technology PC/XT which features only 8-bit memory bus with ISA slot only. Any fault in the system and its operation would directly affect the tank production as this is the only torsion testing machine available in the factory.

V. PROPOSED TECHNIQUE



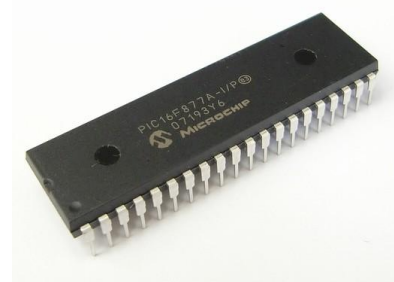
The torque and residual angle of the bar are measured via current sensor and rotary encoder respectively. The torque is determined based on the fact that motor current is directly proportional torque which is a direct indicator of load. The current sensor which is a direct estimation of torque is conditioned properly as it is given to the pic controller to make confirm that no problem occurs to the device. The current is now given to pic controller's analog pin which gives the torque value.

The rotary encoder produces pulses based upon the degree of rotation. In order to find the residual angle, the encoder produces pulses every degree of rotation. When the bar is release from the the current disturbed position to the initial postion,

when the zero torque condition is attained at that time the angle value is measured through the pulse generation of the encoder. The raspberry pi which is used to interface to the output screen to display the required values.

VI. HARDWARE DESCRIPTION

A. PIC (18f4550) MICROCONTROLLER



PIC microcontroller is RISC based device fabricated in CMOS technology that employs distinct bus for the instruction and also for the data which leads to concurrent access of program and memory. The main property in combination of CMOS with RISC are power consumption is very low and the size of the chip is very small with small pin count in it. Compared to other fabrication techniques CMOS is immune to noise. Different kinds of microcontrollers deploys EPROM, EEPROM, FLASH etc. these are

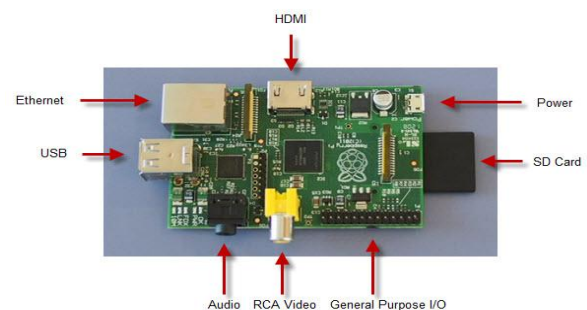
some of the memories of which FLASH is the most recently developed. In PIC18f4550 flash technology is used and data is stored even though power supply is off. Programming is easy and erasing the data is very simple and these are the other features of PIC18f4550.

B. RASPBERRY PI

The Raspberry Pi is a single-board computer which is just a credit card in size evolved in UK by raspberry pi foundation and the motive is that the school level students need gain knowledge about the fundamental of computer science. The Raspberry Pi is inbuilt with Broadcom BCM 2835 SYSTEM and was originally chipped with 256 MB of Random Access Memory, which was later extended to 512 MB. It is not consists of a built-in hard disk or solid-state drive, but SD card is used for booting and persistent storage. For downloading purpose, the foundation adds debian, arch linux ARM distributions. Raspberry Pi which uses raspbian OS involves Python language as the important programming source code.

The raspberry pi consists of 26 GPIO pins. These GPIO (general purpose I/O) signals placed on the 26(2x13) header pins include I2C, SPI, Serial UART, 3V3 and 5V power. The pins deploys 3V3 level of

logic and cannot withstand 5V levels. The board do not have the capability of over-voltage protection. The UART helps the computer for serial communication. It takes the input in the form of data bytes and transmits in a bit order manner in a logical way. Another UART which is at the receiver side organizes the bits into original bytes which is to be same as in the transmitter side. The Raspberry Pi port is designed with transmitter signal and receiver signal which is in the GPIO header.



Raspberry Pi
C. ROTARY ENCODER

A rotary encoder is also called shaft encoder. It is a device that converts angular position of the suspension arm to the required form such as analog or digital. Incremental encoders are based upon the

principle of opto-electronic scanning of index disks which operates upon the transmitted light principle.

The light source used here is LED. As the shaft encoder rotates, the light dark modulation is picked up by opto-electronic elements. In incremental encoders condition, as the the controller does not store the positions and the machine must approach a reference point after each power-off state and while the power is off movements of the machine are not recorded.

The cyclical outputs are provided by incremental rotary encoder if the encoder is in rotating condition and they can in any form such as mechanical or optical. The mechanical type needs debouncing and can be used as digital type potentiometer equipment which includes consumer devices. It is a fact that debouncing is required by mechanical switches, the mechanical type has limitation over the rotational speeds which they can manipulate. When higher speed or a precision with higher degree is required, optical types are used.



Rotary Encoder

D.GEARED MOTOR

Geared motors mainly reduces the motor rotating speed but torque will be increased correspondingly. DC motors have the capacity of rotating at rapid speed so that an electronic device can makes use of. It commonly consists of brush motor and gearbox and these things are connected with the shaft. The main feature of geared motor is providing high torque at minimum shaft speed.

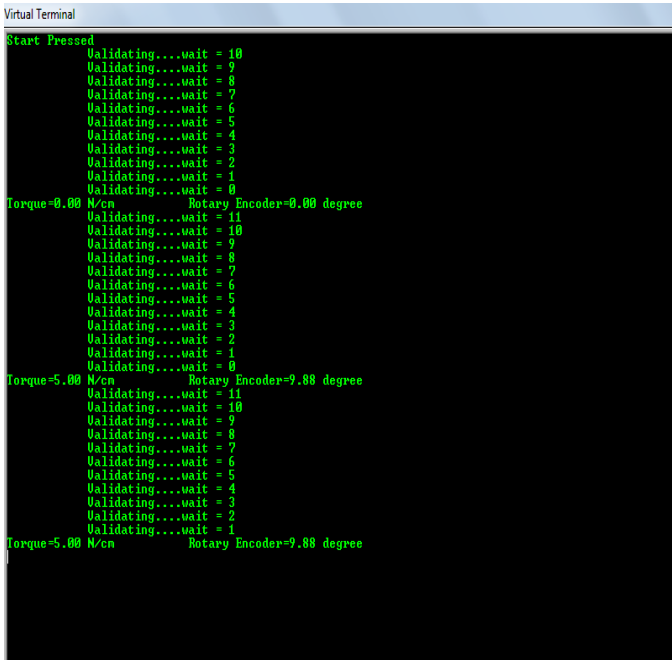


GEARED MOTOR

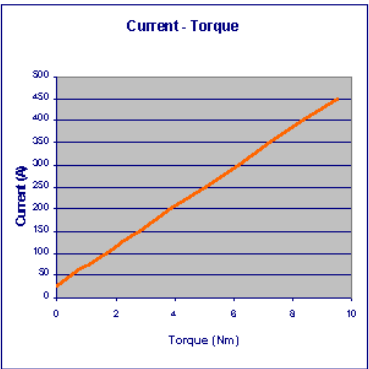
VII.OUTPUT RESPONSE



Snapshot of the kit



Snapshot of the output



Graph

ve graph is based on current vs torque value
e torque increases the current value will also
5.

VIII. APPLICATIONS

- This helps to figure out the most efficient torsion bar required for the manufacturing of heavy vehicles
- It's widely used in many industrial measurements.

- Army purpose: It can be used in Military tanks.
- This idea can be used for all the heavy vehicles which uses torsion bar.

IX. FUTURE SCOPE

The implementation of this mechanism would be of greater importance to the torsion bars manufacturing unit in any automobile industries as it would be a very crucial thing in figuring out whether a bar is defective or not. This is cost effective too. Moreover it is very simple to handle and it will directly read the torque values of a torsion bar based upon that one can decide whether the bar can be provide to the next manufacturing process. By the usage of this testing mechanism we can judge the tensile strength of a bar without much manual power.

X. CONCLUSION

The highlight of the proposed system is, it avoids the dependency of personal computers for data processing to provide necessary control. In simple words, the proposed system replaces the XT-based PC employing add-on cards and employs ARM processor based Raspberry pi and it is compatible with latest devices. The source code developed in python is easy to understand. Hence, the overall

system is compatible with latest technology and reduces hardware complexity.

This project provides an alternative solution to the problems encountered by the WOLPERT machine and helps to achieve the target of tank production for Indian Army every year.

XI. ACKNOWLEDGEMENT

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