

# Automation of Universal Testing machine using Human Machine Interface (HMI)

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**Abstract** - In the material strength test, stress and strain rate are often required to be constant. For example, during the cement quality inspection, the loading rate is required to be  $2.4 \pm 0.2 \text{ KN/S}$  [1]; when measuring the upper and lower yielding points of metallic materials, the strain rate should stay between  $0.00025/\text{S}$  and  $0.0025/\text{S}$ ; In the determination of elongation at break, the stress rate should stay in the range of  $1-10 \text{ N/mm}^2 \text{ S}^{-1}$  when the elasticity modulus smaller than  $150000 \text{ N/mm}^2$  [2]. Since 1950s, Material Testing Machines, which adopted large-flow electro-hydraulic servo, valve to form control system, have appeared in developed countries. Control system of this type could meet the requirements for the stress and strain rate in the material strength test. For example, MTS and Instron from USA, Schenck from German, and Shimadzu from Japan all adopted this type of system. With the improvement of the manufacturing level of proportional valve and the development of control technology, electro-hydraulic proportional valve began to be used as the main control part home and abroad [4]. However, this type of parts, which is vulnerable to pollution, requires medium of high cleanliness. It is of large noise and high price. This type of system could go wrong easily for the complex hydraulic system.

**Keywords:** Stress, Strain, elasticity, hydraulic system,

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## I. INTRODUCTION

Universal Testing Machine is used for several advanced applications like checking tensile as well as compressive strength of materials to be used to build any kind of physical system. Based on this proposes a simple and effective control system, which has a good control effect upon stress rate and strain rate in the application of engineering practice. This type of system can be used in various strength testing device. Test and inspection show that this system, which totally meets the loading requirements of stress rate or strain rate in the national standards, can be used in hydraulic testing machines [7]. The new compact touch screen panel has been presented and implemented successfully by embedded system technology with the current system. So that the most advanced touch screen panel provide clear analytical treatment for load v/s elongation curves, values of stress & strain coming from different channels. The touch screen should also be well-suited in terms of cost, size, smoothness and ease of integration in the circuit boards of measuring devices.

## II. Methodology:

There are three main units with some subunits

- A) Loading Frame
- B) Hydraulic Pumping System
- C) Electronic Control Panel

### A) LOADING FRAME

The Loading Frame consists of a central cross head and a lower table. Center cross head is adjustable for clearance by means of a geared motor. Compression Test is carried out between the central cross head and the lower table whereas tension test is carried out between center and upper cross heads.

Sensing of load is done through a strain gauge based transducer, while the movement of the lower table (ram stroke) is measured by rotary encoder. Safety factors like, over travel limit of center cross head, over range of load are provided as standard with the machine. In our project work through this loading frame we are loading the sample for taking the test. Loading frame provides extra space for the sample

## B) HYDRAULIC PUMPING UNIT

Hydraulic Pumping System consists of multi plunger pump powered by a suitable motor. This pump gives a continuous non pulsating oil flow to the ram of the loading frame. Pressure switch is provided for additional safety against over load. Release valve and load control valve is placed at a convenient position for easy operation by the operator. It also has electrical Control panel for the movement of the cross-head and also for the main pump. Additional switch is provided for fast lift of the ram for initial filling of the gap.

A rotary encoder is fixed along with the ram of the hydraulic unit which indicates the movement of its ram. From this unit we will take output of the sensor fed to the digital indicator unit for further processing.

## C) ELECTRONIC CONTROL PANEL

In current dissertation digital display system is totally microcontroller based. It has RS232 for communication with the computer. The system is supported by window based software. On Line graph of load vs displacement is displayed on the monitor. Analogue readings as well as graphical representation are stored in the file which can be retrieved on demand

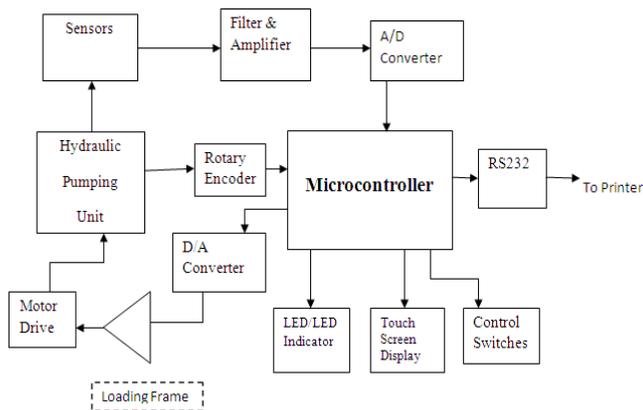


Fig. 1

## E) Working of System

First of all sample under test is to be loaded from the loading frame for taking different tests such as compressive or tensile strength of material. In loading frame position of central cross head decides which test is to be carryout. Central cross head is adjustable & its functionality is

controlled by means of geared motor. Now after loading sample apply the load.

Hydraulic pumping is mechanical unit which helps to apply the load uniformly through all direction. Now sensing of load is done through a strain gage transducer while the movement of ram stroke is measured by rotary encoder. Signal coming from the strain gauge transducer is of very small amplitude & sometimes it may get corrupted due to the effect of noise so to illuminate the effect of noise & to increase the strength of signal amplification & filtration is required. Op amp 741 based amplifiers are well suited to carry out the amplifications. Now this signal is analog in nature we want to go for the further processing that is displaying magnitude of load applied. we must convert this analog signal into digital signal. On chip A to D converter can be used for A to D conversion.

Microcontroller display & record magnitude of tensile or compressive force which is applied to the given sample. RS 232 can be applied for online monitoring of Stress, Strain & load versus elongation curves. Also one more facility is provided in our work that is it will display magnitude of load on human machine interface(HMI) also. Control switches are used to control the action of the moving crosshead during a test - stop, return, or cycle - can be controlled manually by pushbutton switches, or automatically by the functions provided by the limits feature. These functions may be based on the applied load, extension or strain, or to a detected specimen break. LED is used as indicators when carrying out different test on the samples to show which test is going on for the current sample.

## III. Discussion

This paper will provide effective technique of analysing stress, strain & load v/s elongation mechanism which will help us to build up any physical system. With the improvement of the manufacturing level of proportional valve and the development of control technology, electro-hydraulic proportional valve began to be used as the main control part home and abroad.

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