Universal Testing Machine

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***Abstract*— Universal testing machines are used to determine the physical and mechanical properties of raw materials and components by measuring and analysing their performance under varying tensile or compressive forces, in numerous test methods. Micro universal testing machine (UTM) System for composite material property measurement of micro structure is proposed. When they are combined they create a material which is specialised to do a certain job, for instance to become stronger, lighter or resistant to electricity. They can also improve strength and stiffness. To verify the applicability of developed micro UTM system in the micro structure, performance test is conducted. From the performance test, the developed micro UTM system has performance of UTM standard 1828.Developed micro UTM system can be applicable in the micro structure.**

I.INTRODUCTION

A Universal testing machine (UTM) is used to test the mechanical properties (tension, compression etc.) of a given test specimen by exerting tensile, compressive or transverse stresses. The machine has been named so because of the wide range of tests it can perform over different kind of materials. The set-up and usage are detailed in a test method, often published by a standards organization. This specifies the sample preparation, fixturing, gauge length (the length which is under study or observation), analysis, etc.

The specimen is placed in the machine between the grips and an extensometer if required can automatically record the change in gauge length during the test. If an extensometer is not fitted, the machine itself can record the displacement between its cross heads on which the specimen is held. This method not only records the change in length of the specimen but also all other extending plastic components of testing machine. Once the machine is started it begins to apply an increasing load on specimen. Throughout the tests the control system and its associated software record the load and extension or compression of the specimen. Machines range from very small table top systems to ones with over 53 MN (12 million lbf) capacities. Different tests like peel test, flexural test, tension test, bend test, friction test, spring test etc. can be performed with the help of UTM.

II.RELATED WORKS

YanfangLi 2012 The purpose of this study is to investigate a new control algorithm for hydraulic universal testing machine based on extenics. As the variable stiffness of testing specimen affects load stiffness, the theoretical analysis and simulation study of the effect of variable load stiffness on the system were investigated. The degree and tendency of the effect of variable load stiffness on the control quality and accuracy are given. Furthermore, a new extension control algorithm for hydraulic universal testing machine was presented in this paper. The results show that this new control strategy can solve the problems of variable structure parameters of hydraulic universal testing machine, and can realize switch smoothly in variable control modes.

Rui Li,Fang Yang 2017 This paper presents a universal self-aligned in situ on-chip micro tensile fracture strength tester designed for tensile strength extraction and process evaluation, which will provide, for the first time as far as the authors know, great force(above 100mN) to in situ on-chip specimen without the introduction of precise instrument, especially suitable for bulk micromachining related tests. The whole structure and process is simple, so it meets the requirements of various process in massive production, the feasibility

and universality have been proved by practical evaluation of the several foundries. Its advantages also include self- position, self-measure and selfadaption for loading. In our tests, tensile fracture strength of the etched Si film is between 0.13 to 1.2GPa.

Xiao Yan-jun, Zhou Jing, Lu Lin, Guan Yu-ming 2010 Xiao Yan-jun, Zhou Jing, Lu Lin, Guan Yu-ming MCGS (Monitor and Control Generated System, Universal Monitoring System) is a set of configuration software for rapidly constructing and generating computer monitoring system. It can provide solutions, which solve practical engineering program, and also be run on the Microsoft (all 32- bit Windows platform).The data, which is acquainted on site, can be displayed with a variety of ways, such as animation, alarm processing, process control, real-time curve, the historical curve and the report output. It takes full advantage of the Windows' features, such as graphics, good interface consistency, easy-to-use, so it has a more widespread application in the automation field. The tensile test machine control system was designed on the basis of MCGS software industrial control system.

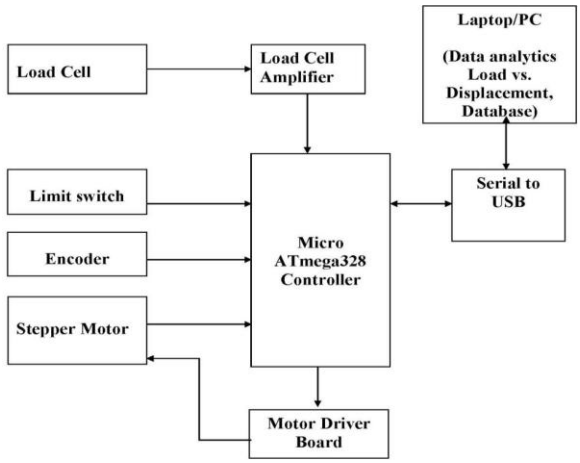
Miao Zhonghua, Yang Fan, Li Baoming, Gu Kang1, He Chuangxin. 2019 The stress and Displacement Control of the universal testing machine in test control process; this paper uses the feed forward PID control algorithm to control the universal testing machine to ach the ieve flexible and accurate control purposes. The hardware implementation of the feed forward PID control algorithm is implemented by FPGA, and an accurate and efficient control system is constructed. The actual test shows that the control system achieves g ood displacement and stress control effects on the universal testing machine, and the control performance is improved.

E Huerta, J.E. Corona, and A.I. Oliva 2010 In this work, the design, construction, calibration and compliance measurement of a universal testing machine for tension tests of materials in film geometry are presented. A commercial load cell of 220 N and sensitivity of 1.2345 mV/V is u sed to measure the applied load. Material strain is measured by movement of the crosshead displacement of the machine with a digital indicator with 0.001 mm resolution and 25 mm maximum displacement, connected to a PC through an interface. Mechanical strai n is achieved by an electric high precision stepper motor capable to obtain displacement velocities as low as 0.001 mm/s. The stress data acquired with a GPIB interface are saved as a file with a home developed in LabView 7.0. Measureme-- strain made program nts of the elastic modulus and yield point of a commercial polymer film (500 HN Kapton) were used to validate the performance of the testing machine. The obtained mechanical properties are in good agreement with the mean values reported by the supplier and with the values obtained from a commercial machine, taking into account the limitations of thin film testing and experimental conditions.

III.PROPOSED SYSTEM

The proposed system consists of (I) sensing module, (II) measurement controller module, (III) Output stepper motor control module and (IV) Analysis UI software module. Sensing module comprises Load cell to get the exact load of the testing material and encoder to get the speed and direction of the Stepper motor. Upper and lower crosshead to hold the test product. Measurement Controller is processing the load and speed values and sends the relevant digital datas to the UI software meanwhile it also controlling the stepper motor rotation and direction as required automatically. The UI software is designed with Visual Studio to keep analyzing the parameters and to plot the load vs displacement graph relevantly. The software also has the ability to captures the peak load (maximum), peak displacement (maximum), tensile and yield strength and display in the UI for the relevant testing material.

BLOCK DIAGRAM



IV.HARDWARE DESCRIPTION

CONTROLLER BOARD:

ARDUINO - ATMEGA328P

Arduino is an open-source project that created microcontroller -based kits for building digital devices and interactive objects that can sense and control physical devices. The project is based on microcontroller board designs, produced by several vendors, using various microcontrollers. These systems provide sets of digital and analog input /output (I/O) pins that can interface to various expansion boards (termed shields) and other circuits. The boards feature serial communication interfaces, including Universal Serial Bus (USB) on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project provides an Integrated Development Environment (IDE) based on a programming language named processing which also supports the languages C and C++.

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter. Arduino Uno has a number of facilities for communicating with a computer, another Arduino board, or other microcontrollers.

PERIPHERAL FEATURES:

Two 8-bit Timer/Counters with Separate Prescaler
Compare Mode– One 16-bit Timer/Counter
With Separate Prescaler, Compare Mode, and Capture Mode– Real Time Counter with Separate Oscillator.
Six PWM Channels– 8-channel 10-bit ADC in TQFP and QFN/MLF package Temperature Measurement.
6-channel 10-bit ADC in PDIP Package Temperature Measurement Programmable Serial USART– Master/Slave SPI Serial Interface
Byte-oriented 2-wire Serial Interface (Philips I2C compatible)
Programmable Watchdog Timer with Separate On-chip Oscillator
On-chip Analog Comparator
Interrupt and Wake-up on Pin Change

Each of the 14 digital pins on the Arduino Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms.
In addition, some pins have specialized functions:

POWER SUPPLY UNIT

Power supply unit consists of following units:
1) Step down transformer
2) Rectifier unit
3) Input filter
4) Regulator unit
5) Output filter

V.SOFTWARE DESCRIPTION

EMBEDDED C:

High-level language programming has long been in use for embedded-systems development. However, assembly programming still prevails, particularly for digital-signal processor (DSP) based systems. DSPs are often programmed in assembly language by programmers who know the processor architecture inside out. The key motivation for this practice is performance, despite the disadvantages of assembly programming when compared to high-level language programming.
If the video decoding takes 80 percent of the CPU-cycle budget instead of 90 percent, for instance, there are twice as many cycles available for audio processing. This coupling of performance to end-user features is characteristic of many of the real-time applications in which DSP processors are applied.

VISUAL BASIC

INTRODUCTION

Visual Basic (VB) is the third-generation event-driven programming language and integrated development environment (IDE) from Microsoft for its COM programming model. Before programming in VB 6, install Visual Basic 6 in computer.

VI.RESULT AND DISCUSSION

The behavior of the material can be tested by different testing methods, with the help of testing machines. The universal testing machine is a material testing machine used for static testing such as a tensile test. It is also known as UTM.

The universal testing machine has two vertical threaded shafts.

Where the movable crosshead will slide on these vertical Bars. The Crosshead will be constant.

These two heads will have locking clamps to hold the specimen in place. Such as wires, rods, for mostly tensile test only.

If it is a tensile test then the specimen will be placed in between the Cross head and the movable head jaws.

If it is a compressive test the specimen will be placed in between the movable head and the table.

There is a speed controller, this controls the speed of the two vertical threaded shafts, as the result, there will be a change in the load applied to the specimen with the help of the movable crosshead.

With the help of the loading sensor measurement, we can observe how much load is applied to the specimen during the test.

In these points, we have discussed the construction and the working principle of the UTM.

VII.CONCLUSION

The application of configuration software makes a fundamental change on the ways of displaying the test results on testing machine; it can exhibit realtime two dimensional curves, which include stress and displacement, and achieve the require ment of tensile tests based on current materials. This system is easy to operate, saving costs and improving the technical content. Multifunction Data Acquisition Card Application has increased experiment data collection accuracy and stability, while the I PC has strong ability to adapt to the work environment, and it is also easy to use. Currently, with the new materials emerging, the experiment of materials' mechanical properties becomes more and more important, this tensile testing machine can satisfy the requirement of mechanical properties of materials, and it has modern typical characteristics of current tensile testing machine.

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