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Design & Development of a Computer Controlled Tensile Strength Testing Machine for Testing of Strings & Fabrics

Ravi Babu Sharma, Jitendra Kumar Rai

Department of Production Engineering, Jaipur Engineering College, Jaipur, Rajasthan, India

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Keywords *— **Tensile Strength Testing, Elongation Mechanical Testing, Image Processing, Ultrasonic Distance Sensing.***

Abstract— *Tensile testing is a primary material science test in which a sample is tension-proof until it is failure. Test results are frequently used to select an application material, to verify quality and to forecast how the material reacts with other forces. The features assessed directly by a tensile test include maximum tensile strength, maximum length and a reduction of the area. From these measures the following characteristics can also be determined: Young modulus, the ratio of Poisson, yield strength and stress resistance. Testing machine is used for the development and maintenance of better information on known materials or the development of new materials. There are many test machines, but the most common of these is the one that tests tensions, compression and bending of the materials. For the test specimen to be tested, the engine must have the proper characteristics. Three major parameters exist: strength, speed, accuracy and precision. The test machine is mainly used in the creation of the stress line diagram. The computer algorithm may be applied tocompute the yield strength, tensile force, youth module or total elongation once the diagram has been generated. The author has designed & fabricated a model for demonstration of the techniques employed using viper motor (DC motor) for force exertion, load cell & instrumentation amplifier of reading force, ultrasonicdistance sensor for measurement of displacement. Simultaneously a tripod mounted webcam is employed to capture real time video & image processing & employed to compute displacement on the basis of motormovement.*

I. INTRODUCTION

Mechanical testing is one of the most essential methods of material study which can assess how deformation and destruction may be resisted by external loads. The insecuritywith which materials and advanced engineering constructions are measured mechanical properties might lead to a reduced operational safety. Therefore, contemporary high-performance test equipment and adequate measuring tools are necessary and important to equipment mechanical testing centers.

Tensile tests are a basic material science test since a sample is exposed to uniaxial tension. The test results are used extensively to pick a material for an application, check the quality of the material and predict how it reacts to other forces. These include: final strength of the tensile, maximum elongation and reductions in the area. These measures can also identify the following properties: the young modulus, the relationship of Poisson, the yield strength and stress- resistance characteristics. Testing machines are utilized for the production or development and maintaining of better information on the materials known.

The electromechanical and hydraulic models are offered for two types of machinery. An electric motor, a gear reduction system, and a transducers move one, two or four screws are used to produce the electromechanical

machine A number of crosshead speeds may be varied by the speed of the engine. A closed loop system based on a microprocessor may be built to control the speed of the crosshead accurately. One or two drive pistons in a manually controlled machine are used by a hydraulic test engine to move the crosshead. In a closed-loop hydraulic servo system, the operator controls the handle valve to control the loading rate. In turn, an electronically controlled servo valve ensures that the needle valve is replaced with accurate control. The electromechanical machine is generally capable of a wide variety of test speeds and prolonged cross-head displacements, but it is an affordable option to produce big forces.

1.1 Objective of the Proposed Research Work

[1.] Design & Development of a automatic tensile strength or elongation testing system that combines the best of Vision Processing & Sensor/Signal Technologies.

[2.] Use of advanced image processing algorithms to measure elongation speed(s), & movement of timing strips to monitor displacement & thus elongation over time.

[3.] Use of advance sensing technologies to monitor real time tensile testing parameters using sensors such as force, temperature, load etc & image processing data such as snap point, elongation movement etc.

[4.] Use of computer processing & tabulation algorithms in conjunction with sensor technology to integrate tension/stress over time to form automated lifecycle, durability testing system.

[5.] Use of fuzzy logic & artificial intelligence algorithm for real time control of tension motor force in highly energy efficient and accurate method with minimal overshoot.

II. LITERATURE REVIEW

Aizhan Erulanova et. all Tensile testing plays an important part in developing higher-source nodes, the reliability of which restricts the existence of mobile mechanical systems. Materials need to withstand minimal loads and preserve their integrity, shape and size, and high-quality voltage tests are essential. Mechanical testing is one of the most important material test methods for evaluating their ability to cope with external load deformation and destruction. Insecurities regarding the mechanical characteristics and function of materials, modern engineering systems, can reduce safety [1].

Siti Nadia et. all This paper explains the tensile behaviour of composites with various fiber volume factions in jute- polypropylene fibers. Composite laminates made from weaving jute fiber were prepared using lamination by hand with the fiber volume percentage of 20-80% and polypropylene folds. The laminates were tensile tested in accordance with ASTM D3039. The experimental results showed that the fiber-to-resin material influences greatly the composite tensile characteristics. The tensile strength and Young's composite modules with the growing fiber volume fraction are rising [2].

Włodzimierz Szewczyk et. all For many practical applications of paper and paper materials, breaking energyis of great importance. It is performed in a one-way tensile test on paper by external forces before its fall. The paper analyses the impact on the energy consumed by paper moisture content during the tensile tests within the range of humidity balance achieved in the paper air conditioning system at a temperature of 23 °C. Two measurement methods have been proposed to forecast changes in energy breaking caused by changes in moisture content [3].

Lenin Jimenez et. all The aim of the project is to create and design a virtual instruments (VIS) system for the automation of tensile tests for material characterization within the Electromechanical Engineering Laboratories. The frame is built on a sturdy hardware architecture, excellent data accuracy is given and a virtual tool automatically defines the test curve and testing characteristics. [4].

Bandit Suksawat et. all The tensile test machine was constructed in order to detect true carbon steel stress and strain, and a specimen projection diameter was proposed to measure the area effectively. The main parts of tensile testing, top and bottom tensioning aggressors, a 1,000 kg load-cell tension force measuring cell, 0.5 μm LVTD sensor and average 1,280 0.700 pixel, 30 frames per second in depth, are a hydraulic cylinder and a hydraulic tensioning machine. [5].

S Nabila et. all Jute is a natural fiber with relatively low cost and high volume yield, which is environmentally friendly. The goal of this study was to assess the effects of polypropylene (PP) strengthened weight fractions of jute fibers in order to achieve optimal PP/jute composite properties. For pretreatment, jute fiber was alkalized. The PP was rendered initially via the extrusion process, and the composites were produced with a hot press device for compilation into the lamina of the PP matrix and jute fiber [6].

Weilai Yao et. all The significance of concrete tensile strength affects the efficiency of structures such as hearing resistance and the load bearing capacity of

concrete cone failure anchors as a critical method of failure. The tensile stress is also a significant mechanical feature to be properly considered in building as a concrete compressive strength. For the evaluation of structures, particularly those that exist for years, there are the real value of in situ tensile and a concrete compression strength that have long been deteriorating in realistic service settings [7].

M.S. Parmar et. all An instrument to measure the smoothness of finished fabrics has been designed and developed. The pendulum theory is the basis of the instrument. A roller less wheel, moving along the arc-shaped platform is part of the weight (string hang). As a sample holder the platform serves. When the weight is pushed, the platform swings back and forth. Owing to fabric friction, the amplitude of the swing decreases. Inverse proportion to the rust or rugging of the cloth is the amplitude [8].

Yi Zhou et. all Modern body armour used for ballistic defence consists of several layers of tissue and other types of cloth and helps to absorb and dissipate projectile kinetic energy to end high velocity projectiles. This mechanism is generally recognized as interplaying many factors that affect the effect of the yarn pull-out by the inherent textile structure (the interlacing of the warp and weft yarns) [9].

Naoki Hayakawa et. all A micro scale tensile fatigue test device has been designed by Authors to test specimens made from bulk materials. The micro-manipulator is attached to the probe and enables precise initial placement and tensile stress application. The present study covers the process and conclusions of traction tests on specimens constructed from magnesium alloy ground grain AZ31 and tensile fatigue tests. [10].

S.R. MISHRA et. all Accurate measurement of diverse geosynthetic characteristics is necessary for proper quality control and design procedures. A considerable parameter of all mechanical properties needed to be designed is the tensile strength of geosynthetics. At present, during geosynthetic tensile testing, test techniques in laboratories are incapable of measuring local stresses. These stressed materials have a substantial impact on their geosynthetic performance, due to production flaws, seaming, puncture and tearing of the textile [11].

Daudi S. Simbeye et. all The universal testing machine's measuring and control system was used in data collection and processing and closed-loop control of the actuators was carried out. This is a complete automated test platform for measuring devices and control technology. The Electronic Universal Test Control System was developed and implemented based on studying relevant technology and specifications. The system determines the mechanical properties of materials such as tensile and elongation, strength, distortion and displacement, and assumes good performance [12].

Serkan Nohut et. all The spun bond nonwoven materials of polypropylene (PP) are particularly essential for the health, furniture and household industries. Subjects with high tensile strength are needed in these industrial applications. Digital image analysis (DIA) in the textile industry is widely used in the determination of fabric property and online controls. The literature well establishes the measurement of textile weight by means of digital image processing.

However, limited knowledge on tensile strength prediction and break elongation can be given with digital image analysis (DIA) [13].

Piotr Przybysz et. all Paper is a versatile product utilized in daily life and in various industries and businesses. The manufacture and use of global paper goods is expanding gradually at 400 million tonnes. Paper goods also comprise environmentally-friendly components from fibrous crops, mainly wood and recycled streams, such as pulp, as part of their usefulness and relatively low prices. [14].

Mohammed Naveed et. all Over the last few years, demand for mechanical properties in aerospace, automobile, defenses, etc. of aluminium matrix composites (AMCs) has gradually increased. Thanks to its excellent wear resistance and manufacturing ease, Al6061 is very popular for all available aluminium alloys. The distribution of an acceptable combination of hard ceramic powder and aluminium fillers gradually leads to the use of new techniques to improve the durability and wear resistance of Al6061 [15].

III. METHODOLOGY

3.1 Proposed System Block Diagram

In this block diagram we can 220 volt ac supply goes to step down transformer then it converted in to 12 volt/5 amp supply then is goes to rectifier circuit for convert it to dc supply after this battery is connected for store energy in the form of dc voltage. After this voltage regulator circuit is used for regulate voltage. Regulated voltage supply is used for power up our main control unit and circuit. Load cell is connected to microcontroller and ultrasonic sensor is used for measure distance. Here we use PIC microcontroller for perfume operations. 16x2 LCD display is used for print the data. Relay driver circuit is used for drive relay

according to wanted direction of viper motor. USB to TTL converter is used for transmit data to our computer and laptop for analysis.

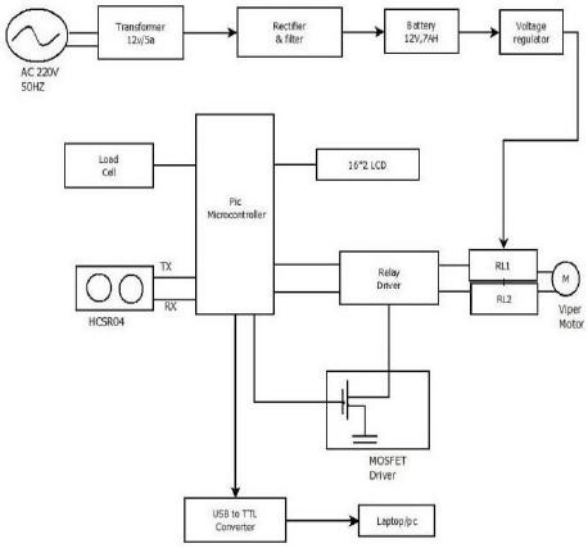

Fig.1: Block Diagram

3.2 Flow Chart of MATLAB Implementation

Implementation The above flow chart is the our MATLAB implementation code flow chart in this flow chart we can see 1st our code is start then clear screen, RAM and all opened files. Then initialize all the variables. Then initialize variable Pos [270140 100 200]. Then display menu functions that is previewline video stream, define ROI , Test real time marker detection, start test and quit. Then get input from user. Thenswitch to Y, here five cases are available these are , case 1 isreal time video preview, case 2 is call define region of interest, case 3 is call test real time marker detection, case 4call start test case 5 is quit.

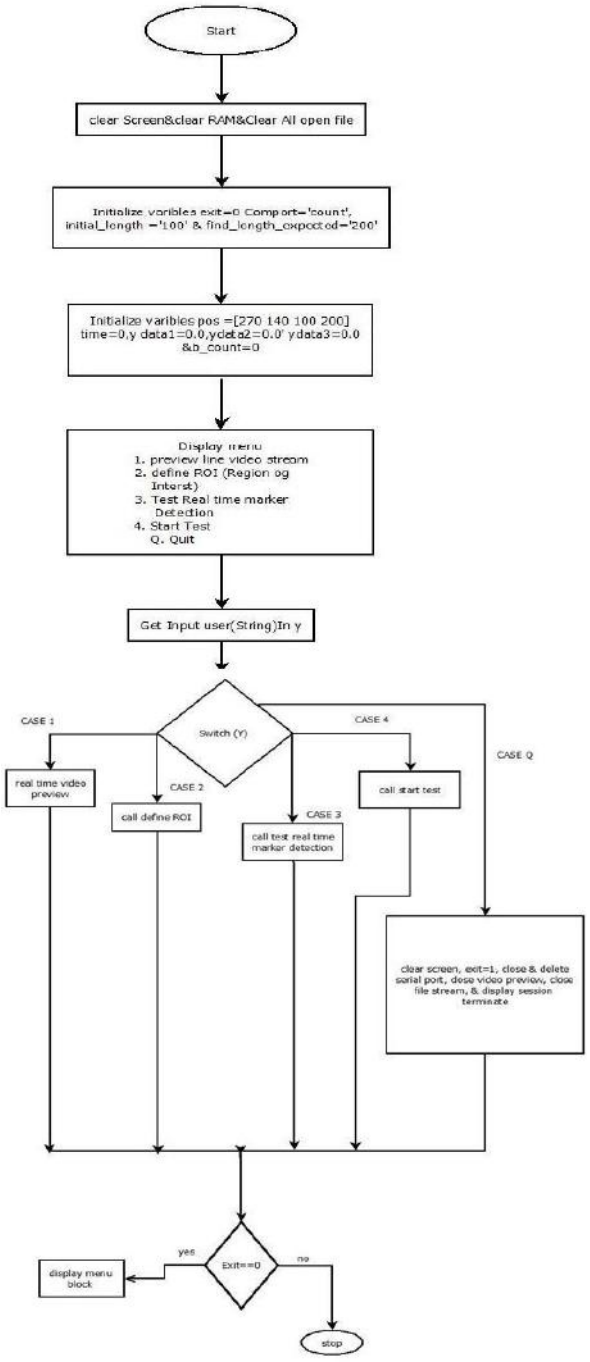

Fig.2: Flow Chart of MATLAB

3.3 Real Time Video Preview Module Flow Chart

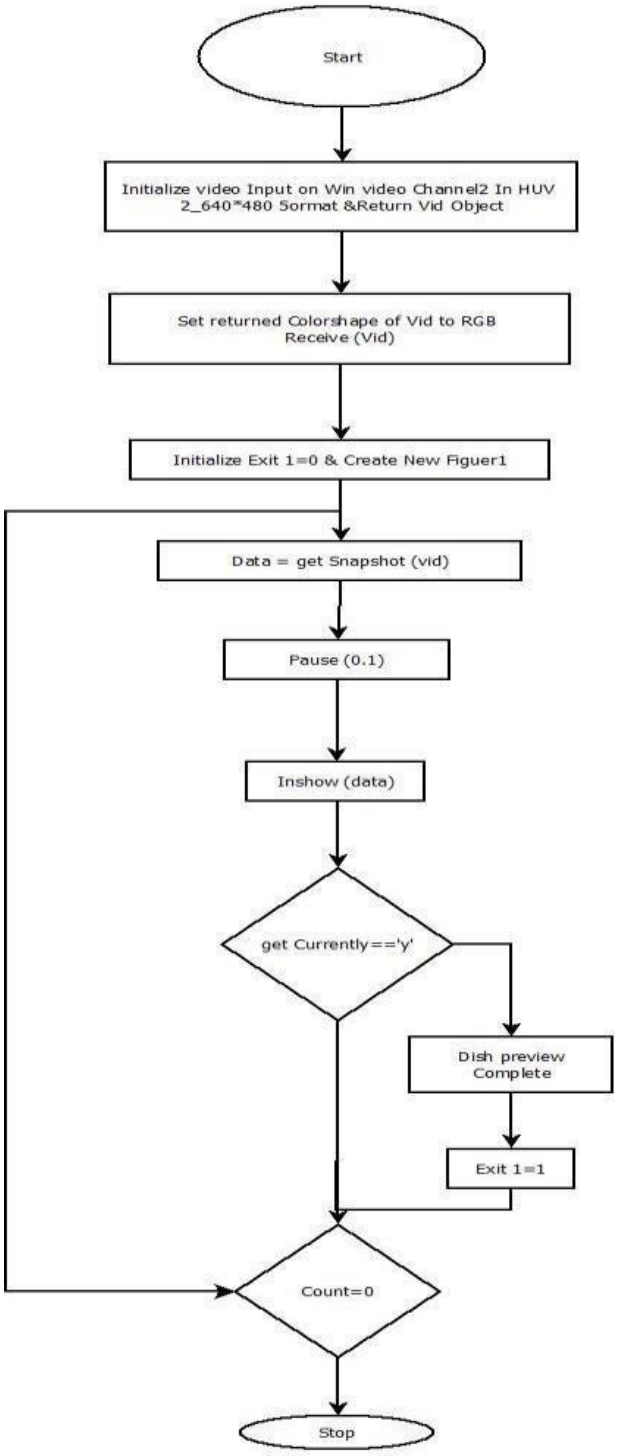

Fig.3: Real Time Video Preview Module

The above figure is the flow chart of real time video preview module program. In this flow chart we can see 1st module code is start then initialize video input on win video channel2 in HUV2 on 640X480 format. Then set color shape of vid to RGB. Then initialize exit1=0 & create new figure. Then get snapshot then pause video. Then some condition will be apply that is if current key == 'Y' then dish preview complete and exit1 =1, then if count = 0 then algorithm will be stop if count not equal to zero then algorithm goes to data = get snapshot(vid).

IV. RESULTS

4.1 Proposed Hardware Design

Fig.4: Hardware Image

4.2 Jumper Wire Results

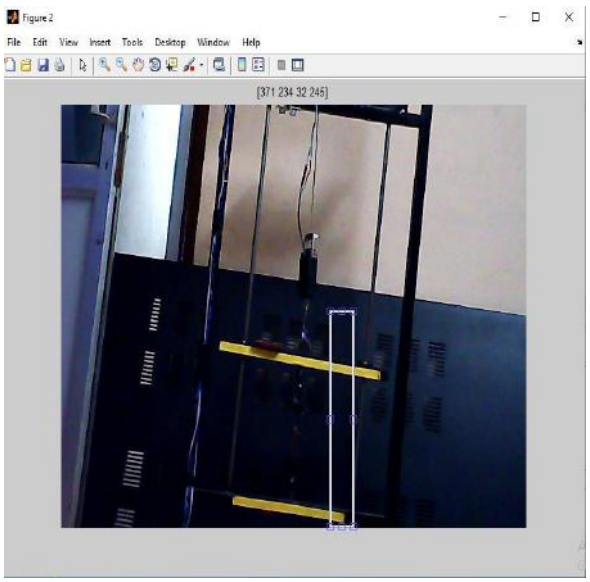

Fig.5: ROI

In this window we can see the Region of interest because our selected option is 2nd. Here region of interest is [371 234 32 245]. Region of interest is calculated by yellow colour of both bars.

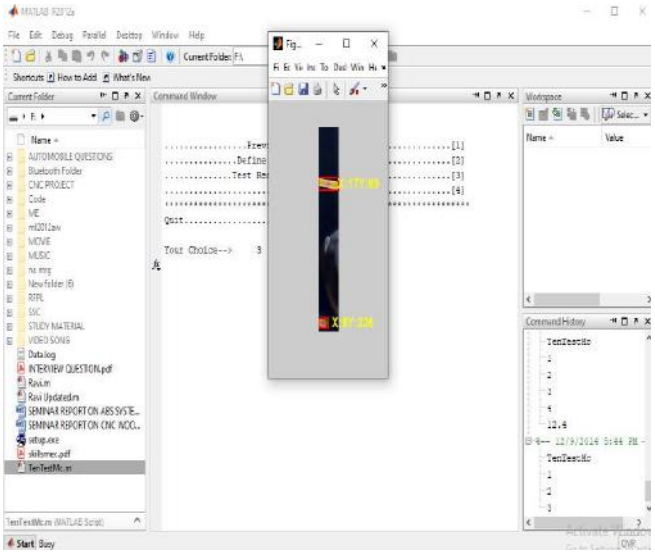

Fig.6: Marker Detection

In this window we can see real time marker detected centroid of yellow colour marked bar. That is for upper bar X:17Y:69 and for lower bar X:8Y236.

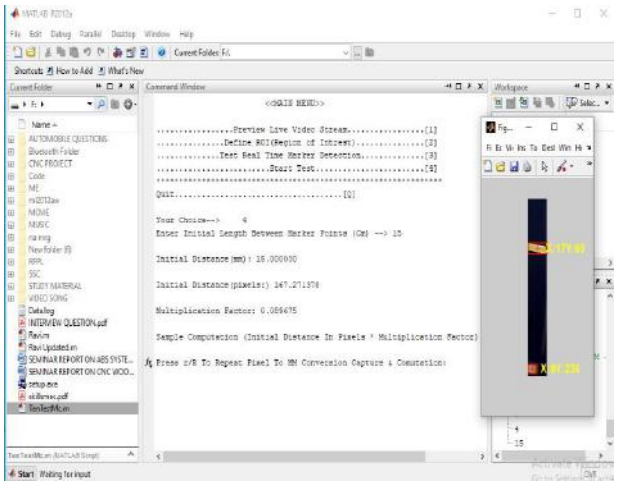

Fig.7: Test result values

In this window we can see the test results values that isgiven below:

Length Between Marker Points is 15 mm. Initial distance (Pixels) – 167.271378 Multiplication Factor is: 0.089675

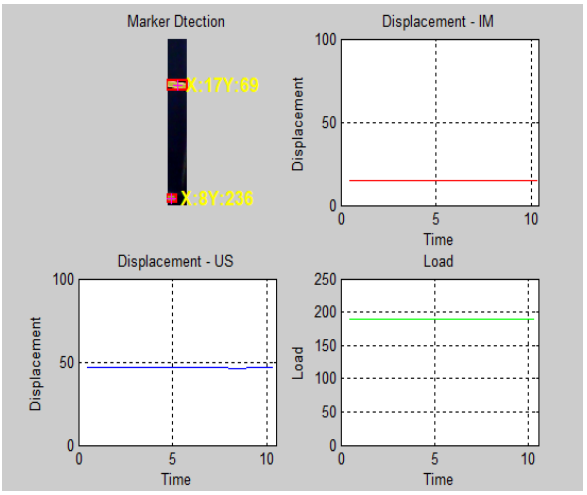

Fig.8: Graph Plots1 of jumper wire

In this figure we can see time and displacement graph and we can also see load and time graph with short range.

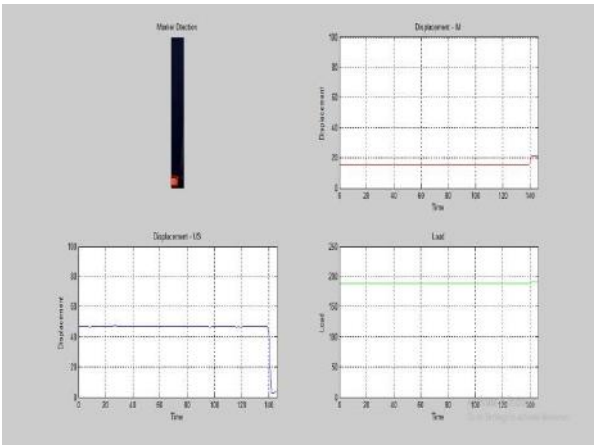

Fig.9: Graph Plots2 of jumper wire

In this window we can see graph plot between time and displacement and we can also see graph plot between load and time with wide range.

As above process we take outputs for three type of wires that's are jumper wire, plastic and soldering wire. Outputs of these 3 wires tabulate in below table.

Table: 1 Results Output

S. No.	Wire Type	Initial distance	Initial distance pixels	Multiplicationfactor
1.	Jumper wire	15mm	167.271378	0.089675
2.	Plastic wire	15mm	168.255554	0.089150
3.	Soldering wire	15mm	159.437564	0.094081

V. CONCLUSION

Tensile testing & measurement of elongation properties of materials is an important aspect of material testing. Accurate& reliable determination of these properties are crucial to infrastructure development & civil/mechanical engineering application, however these are highly time consuming & operator intensive. The proposed system has been developed to automatic the process of tensile testing as elongation testing by using computer assisted combination of image processing & sensor technology.

The proposed system uses combination of ultrasonic displacement senor with image processing. Displacement order force is measured using image processing & ultrasonic sensor, both techniques are employed to improve the accuracy of measurement by using mathematical techniques of both displacement data such as weight averaging. Asdemonstrated by the result above the proposed system has been successfully implemented & tested. Both image processing & ultrasonic displacement show some curve pattern of displacement, also the depiction of material break under force is shown in load curve, thus proving the working of the designed system.

VI. FUTURE SCOPE

The proposed computerize tensile strength or elongation testing machine has been successfully developed & demonstrated. However with the modernization & advancement of computer & sensor technologies, it is imperative to enhance or upgrade the developed system to meet the needs & challenges of the future. One of the most sought updated would be to incorporate artificial intelligence or machine learning to hybridize displacement data captured form both the technique to assimilate an accurate displacement curve. Also artificial intelligence & machine learning can be employed to detect break of material order test, & automatic determination of quality of material order test by of saving the captured data.

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