

# “Arduino Based Hardness Testing Machine”

<sup>[1]</sup> Vironika Kulkarni <sup>[2]</sup> Neha Kasar <sup>[3]</sup> Mohsina Inamdar <sup>[4]</sup> Supriya Kurlekar.

<sup>[1][2][3][4]</sup> Sharad Institute of Technology, College of Engineering, Kolhapur, Maharashtra, Yadrav

**Abstract:** -- Hardness is the property of material that enables it to resist plastic deformation, penetration, Indentation and scratching. Therefore, hardness is important from an engineer standpoint because resistance to wear by either friction or erosion by steam, oil, and water generally increase with hardness. There are two methods of hardness testing Rockwell and Superficial Rockwell. These test methods cover the determination of the Rockwell hardness and the Rockwell superficial hardness of metallic materials by the Rockwell indentation hardness principle. In the conventional system load and dial gauge assembly is manually adjusted to estimate hardness. We have proposed Arduino controller based system to measure and process related data so as to avoid manual errors and to improve accuracy of estimation the all the reading will be displayed on Nextion display and Printed data output will also made available with PNP-64 thermal printer interface.

Through this paper we have proposed state of art technology using Arduino controller and Nextion display to make hardness testing more sophisticated and user friendly.

**Keywords:** - Arduino, Nextion Display, PNP-64 Thermal Printer

## I. INTRODUCTION

The principal purpose of the hardness test is to determine the suitability of a material for a given application. Fig. shows block diagram of hardness tester. It consists of 2 limit switches, Arduino, dial gauge, Nextion hmi display and printer. Dial gauge is very important component in Arduino based hardness testing machine .Dial gauge is used to measure small linear distances that are important in the establishment of precision and accuracy. In this hardness testing machine dial gauge is used to measure the hardness of material. Plunger is moving part of dial gauge. When plunger moves dial gauge shows readings. Arduino is also most important part, it is easy to use and quickly understand. There are various types of Arduino. In this hardness testing machine we use Arduino mega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It has 256 KB of flash memory for storing code, 8 KB of SRAM and 4 KB of EEPROM. Nextion is a Seamless Human Machine Interface (HMI) solution. Nextion works on 5v supply; it has 4 pins that are Vcc, ground, transmitter and receiver. The Nextion display uses only one serial port to communicate hence It avoids number of wires.We notice that most engineers spend much time in application development but get unpleasant results. In this situation, Nextion editor has mass

components such as button, text, progress bar, slider, instrument panel etc. to enrich your interface design. The PNP-64 is 2 Inch Thermal Panel Printer. It has compact size and in this printer paper loading and mounting is very simple and easy. It has high resolution and low noise.PIN Connection:- 1) Power GND (Black) 2) +5VDC (Brown) 3) +8.5VDC (Red) 4) DATA (Orange) 5) BUSY (Yellow) 6) GND (Green). The next part in block diagram is Max 232. This IC is widely used in RS232 Communication systems in which the conversion of voltage level is required to make TTL devices to be compatible with PC serial port and vice versa. The last block is motor, this is AC motor and it operates on 230v.

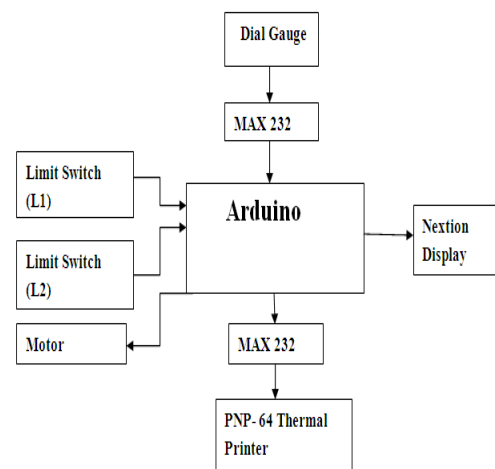


Fig. Block Diagram

## II. METHODOLOGY:-

Fig. shows system flowchart. First switch on the power supply and cycle starts. First it checks position of home limit switch. If home limit switch is in high state that is equal to one then dial gauge starts measure reading. Dial gauge capture first reading in between 3000 and 3300. If home Limit switch is in low state then start motor. After capture first reading it checks position of dwell limit switch. If dwell limit switch is in high state that is equal to one then stop motor and start timer. This timer (dwell time) is user define so as per our convenience we can select dwell time. For given dwell time the operation of machine stop working. After completion of dwell time operation of machine starts. The next step is again check the position of home limit switch. If home limit switch is in high state that is equal to one then stop motor and dial gauge capture the second reading then calculate difference of first and second capture readings. This difference is denoted by 'e'. Finally hardness value is calculated. There are different hardness formulae for different hardness scales.

For HRA, HRC and HRD: -  
 $HARDNESS=100-e$

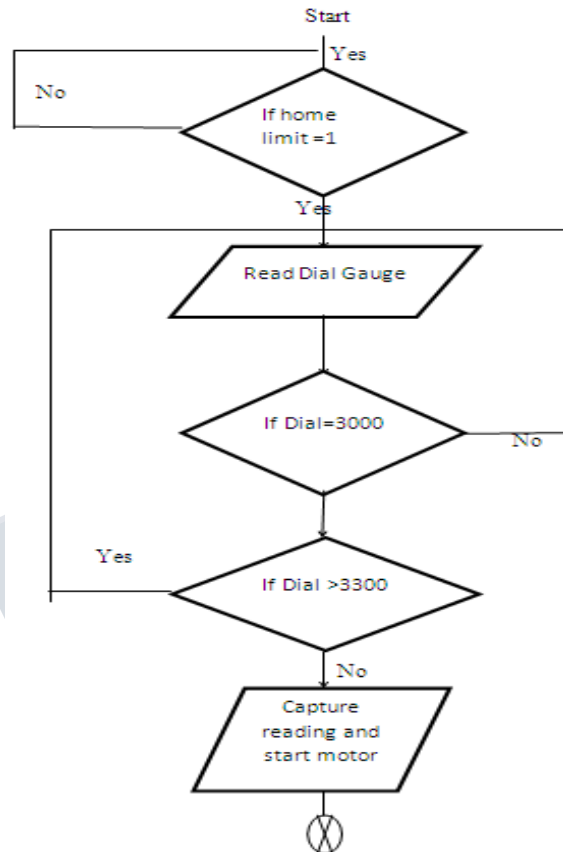
For HRB, HRR, HRE, HRF, HRG, HRH, HRK, HRL, HRM, HRS, HRP and HRV: -

$HARDNESS=130-e$

For 15N, 30N, 45N, 15T, 30T and 45T: -  
 $HARDNESS\ 1=2*e$

i.e.  $HARDNESS=100-HARDNESS\ 1$

**SYSTEM FLOWCHART: -**



**Types of Rockwell Hardness Method: -**

**A. Rockwell Hardness Test**

**B. Rockwell Superficial Hardness Test Rockwell hardness test: -**

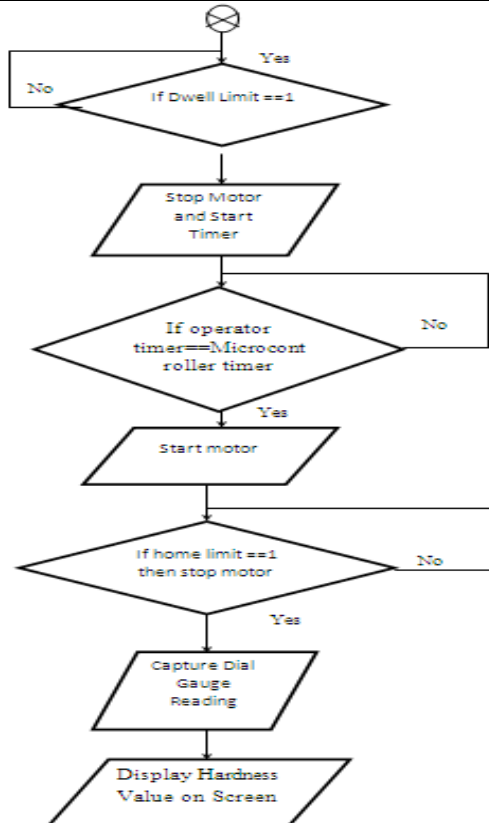
- ◆ The Rockwell scale is a hardness scale based on indentation hardness of a material.
- ◆ The Rockwell test determines the hardness by measuring the depth of penetration of an indenter under a large load compared to the penetration made by a preload.
- ◆ There are different scales, denoted by a single letter, that use different loads or indenters. The result is a dimensionless number noted as HRA, HRB, HRC, etc.
- ◆ 64 HRC means RHN of 64 on C- scale, (diamond indenter and 150 Kg major load)

**Rockwell superficial hardness test: -**

- ◆ The Rockwell Superficial hardness test method consists of indenting the test material with a diamond cone (N scale) or hardened steel ball indenter.
- ◆ Rockwell superficial scales are used to test materials too thin or small for the regular scales or outside the regular ranges.
- ◆ Superficial Rockwell hardness scales are N and T for metals and W, X and Y for nonmetallic materials and soft coatings.
- ◆ 81 HR 30 N means SHN 81 on 30 N-scale (30 N diamond indenter and major load 30 Kg)

**Two types of test based on load**

Load	Rockwell	Superficial
Minor	10Kg	3 Kg
Major	60,100,150 Kg	15, 30, 45

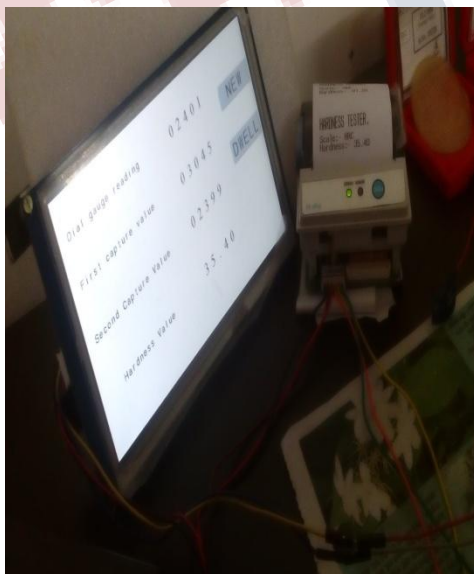
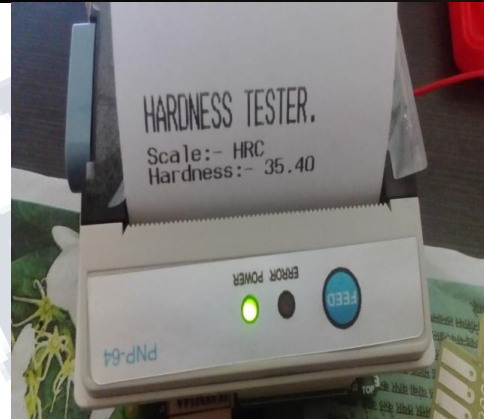
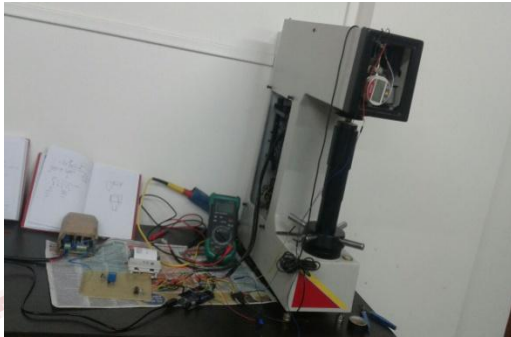
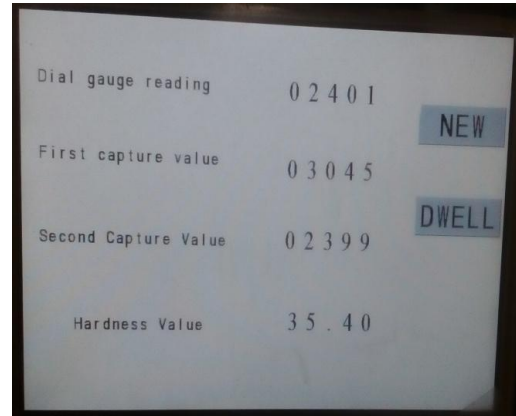
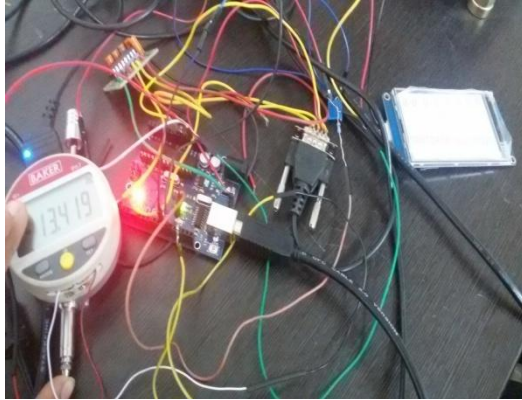


TYPICAL APPLICATIONS OF ROCKWELL TEST SCALES	
SCALE	APPLICATIONS
A	Cemented carbides, thin steels, shallow case-hardened steels. Only scale that is continuous over a wide range of material hardnesses.
B	Aluminum, copper, soft steels, and malleable iron.
C	Hardened steels, hard irons, deep case-hardened steels, titanium.
D	Thin steels, medium case-hardened steels, and pearlitic malleable iron.
E	Cast iron, aluminum, magnesium, and bearing metals.
F	Annealed coppers and thin, soft sheet metal.
G	Phosphor bronze, beryllium copper, and malleable irons.
H	Aluminum, zinc, and lead
K,L,M, P,R,S,V	Bearing metals and other very soft or thin materials.
N	Same materials as for HRA, HRC, and HRD, but thinner gauge or case depths.
T	Same materials as for HRB, HRF, and HRG, but for thinner gauge.
W,X,Y	Bearing materials, plasma spray coatings.

Rockwell Hardness Test Scales		
Scale Symbol	Penetrator	Load kg
A	Brale	60
B	1/16-in. Ball	100
C	Brale	150
D	Brale	100
E	1/8-in. Ball	100
F	1/16-in. Ball	60
G	1/16-in. Ball	150
H	1/8-in. Ball	60
K	1/8-in. Ball	150
L	1/4-in. Ball	60
M	1/4-in. Ball	100
P	1/4-in. Ball	150
R	1/2-in. Ball	60
S	1/2-in. Ball	100
V	1/2-in. Ball	150

Superficial Tester Scales		
15N, 30N, 45N	N Brale	15, 30, 45
15T, 30T, 45T	1/16-in. Ball	15, 30, 45
15W, 30W, 45W	1/8-in. Ball	15, 30, 45
15X, 30X, 45X	1/4-in. Ball	15, 30, 45
15Y, 30Y, 45Y	1/2-in. Ball	15, 30, 45

**Hardware: -**



**Future Scope: -**

1. Arduino plays a significant role in this project. It is widely used because of its low cost, less complex structure and it is easy to understand and programming is very simple so better future of this project.
2. In this project we are used Nextion display, it is a new technology, due to use of Nextion display number of wires get reduced because Nextion display use only one serial port for communication.

**III. CONCLUSION**

The Rockwell technique can be performed quickly making it ideal for quality control. It also leaves only a tiny impression on the specimen and is capable of

being used on a wide variety of materials and geometries. Hardness testing is to measure of hardness of materials resistance to localized plastic deformation.

**REFERANCES**

- 1) S.P. Rockwell, "The Testing of Metals for Hardness, Transactions of the American Society for Steel Treating, Vol. II, No. 11, August 1922, pp. 1013–1033.
- 2) ASTM International Standard E18, *Standard Test Methods for Rockwell Hardness of Metallic Materials*, ASTM International, West Conshohocken, PA, 2011.

