

ROCKWELL BASED HARDNESS TESTING MACHINE

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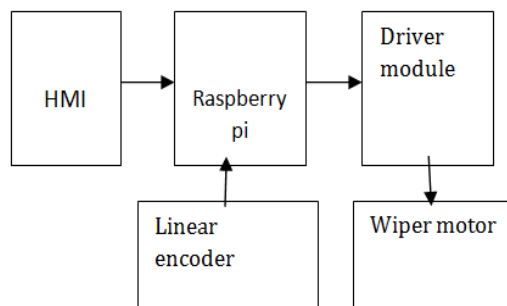
Abstract – The measurement of hardness is widely used by many of the world’s manufacturing industries. The hardness tests are the most commonly used methods for testing and production quality-control of metals and metallic products. This paper represents that hardness testing machine using digital system. Where semi-automatic motorized digital machine, raspberry pi based panel is used. We can get hardness in digital version, where parallel port for connecting dot matrix printer is also used. This machine operates in three modes motorized automatic mode, motorized mode & manual mode. In this project automatic weight selection by thumb wheel is provided.

Key Words: indenter, penetrate, hardness, raspberry

1. INTRODUCTION

P. Rockwell invented the Rockwell hardness test to get more accurate and rapid measurement. After that Charles H. Wilson expanded on Rockwell’s invention. The Rockwell is a hardness scale based on indentation hardness of material. The Rockwell hardness test based upon Measurement of depth to which an indenter is forced by major load beyond the depth resulting from a previous load(minor) load. The principle of working is firstly minor is applied. A zero position is recorded. After that major load is applied and the maximum penetration position is recorded. After that remove the major load until minor load is reached. Resulting Rockwell no. displayed. It is difference between major load and minor load. The indenter may be either a diamond cone & tungsten carbide ball, depending upon the characteristics of the material being tested. In this project paper, this machine is designed for measuring hardness of metals & alloys, whether round, flat or irregular in shapes. This machine is ideally suitable for laboratories, tool rooms, heat treatments shops, R&D departments, inspection departments, foundries & educational institutions. Automatic weight selection with automatic zero setting dial gauge. Motorized versions are also available.

2. BLOCK DIAGRAM



HMI:



A human-machine interface (HMI) is the user interface which connects the system and user to control the system. MI translate the system data into the human-readable visual representation of the system. It used to connect human to machine. With the help of HMI easy to understand graphics display. Functions for converting values and compensating for curved surface.

Raspberry pi:



Raspberry pi is easy to use as compared to the other models. It has 1GB DDR3 RAM which helpful in Rockwell based hardness testing machine because it requires more space to store information or calculations. In this project we can use raspberry pi3 model B+ .it includes a GB wired LAN adapter, different 802.11n WIFI cards.

Driver module:

When we working with electronics project which used microcontroller/raspberry pi, it requires relay to control AC voltage or high voltage and this driver module provide isolation between raspberry pi circuit and high voltage operating loads.it includes optocoupler,ULN2003 and relay etc.

Wiper motor:



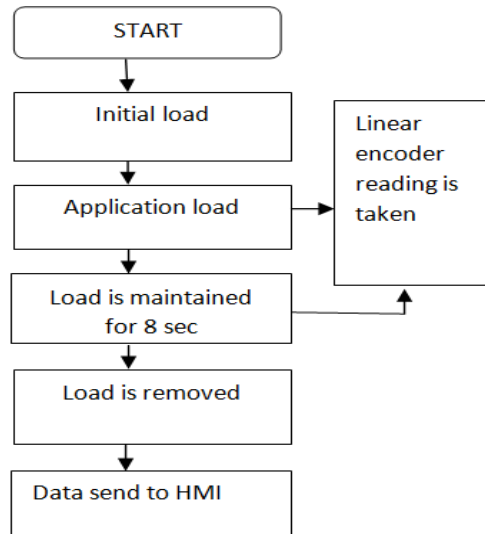
In this project wiper motor 17w 24 v is used. Designed for wind shield wiping on light commercial and commercial vehicles.

Linear encoder :



Linear encoder is traducer or sensor which convert encoded position into analog or digital form. Here it will detect position of minor load and major load and convert it into digital output.

3. FLOW DIAGRAM:



Different types of parameters of test can set on setting screen on touch screen. In normal mode, preload(minor load) is applied. And zero data is recorded after that a major load is applied for specific time of period because of that penetration depth beyond the zero data which is previously established by the minor load.

After that the specified dwell time for major load, the major load is removed by keeping Minor load.

This loading and unloading reading taken by the encoder.

This data sends to the HMI. The difference between minor load and major load which is Rockwell hardness number displayed on HMI screen.

4. TABLES, FIGURES AND EQUATIONS

4.1 Tables:

1. In this project paper different scales are used to measure hardness, depends on scale different metals are used as shown as follows:

Scale symbol	Typical applications
A	Cemented carbides, thin steel & shallow case-hardened steel
B	Copper alloy, soft steel aluminum alloys , etc.
C	Steel , hard cast iron , titanium and other materials harder than B100
D	Thin steel and medium case- hardened steel.
E	Cast iron, aluminum & magnesium alloys, bearing metals
G	Phosphor bronze, beryllium copper, malleable irons,
F	Annealed copper alloys, thin soft sheet metals
H	Aluminum, zinc lead

2. For different scales, different indenter are used which is depend on load. Which is as shown in table as below:

Scale symbol	indenter	Load (kgf)
A	Diamond	60
B	1/16*Ball	100
C	Diamond	150

D	Diamond	100
E	1/8*Ball	100
F	1/16*Ball	60
G	1/16*Ball	150
H	1/8*Ball	60
K	1/8*Ball	150
L	1/4*Ball	60
M	1/4*Ball	100
P	1/4*Ball	150
R	1/2*Ball	60
S	1/2*Ball	100

5. Equations

The formula used for the calculating Rockwell hardness values are as follows:

1. For regular Rockwell hardness using spheroconical “brale” indenter

$$HR[scale] = 100 - h/0.002$$

Where scales is A, B,C,D & depth penetrated in mm.

- 2.Using steel ball:

$$HR[scale]= 130 - h/0.002$$

Where scales is B, E, F, G etc. and h in mm.

3. for superficial Rockwell hardness using indenter.

$$HR=[(total load) scale] = 100 - h/0.001$$

Where total load is 15, 30, or 45kgH in mm.

6. DEMO PROJECT:



CONCLUSION

In normal Rockwell based hardness testing machine it operated manually, the test force selection is done by manually. In digital Rockwell based hardness testing machine, It is motorized testing machine which provides automatic operations cycle. It includes load, dwell and unload operations. Or externally dialing is done by LCD display.

REFERENCES

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