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Automation in Measurement of RLC

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Abstract—
Measurement of electrical parameter such as Inductance (L), Capacitance(C), and Resistance(R) plays an integral role in the real world implementation of the circuits. This paper is focused on automatically detection of elements such as resistor, inductor, capacitor and measurement of parameters related to it.This simple techniques leads a low cost device at the beginner level. The device uses ArduinoNano for detection of elements with auto scaling and auto ranging functions. The reason behind the implementation of this device is that traditional method uses manual work of knob selection which is time consuming. By understanding the physical characteristics of these devices we can detect and measure them through automation.

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I. INTRODUCTION

A RLC Meter is an electronic device that measures the inductance, capacitance and resistance of circuit components. Many RLC meter are available in present market for example sr720 and sr715 meters, IET labs 7600 series, ms5308, 879B form BK precision, etc.

Generally these meters have selection knobs and buttons for specific elements which is time consuming. By making automatically detection of elements, measurement takes place. Here, the device comes with dual function. For example, it is necessary to carry out the inductance as well as resistance of motor winding, this can be achieved with this device.

II. MEASUREMENT TECHNIQUES

A. MEASUREMENT OF RESISTANCE:

The figure above shows the circuit diagram of a simple resistance measurement scheme. Rx is the resistance to be measured. R1 is the input resistance. i is the current passing through the loop and 5V is the supply voltage. To find theunknown resistance Rx, the voltage across Rx is measured first. Let the voltage across R1 be VR1. Then,

$$VR1=5-Vx.$$

The current,

$$i=VR1/R1= (5-Vx)/R1.$$

Since R1 and Rx are connected in series, the current through them will be equal. So the unknown resistance

$$Rx= Vx/i$$

The voltage across the unknown resistance is measured using the ADC of the Arduino.

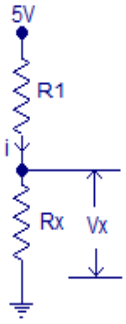

FIG.NO.1 RESISTANCE MEASUREMENT

A. **Capacitance Measurement**:

Capacitance is a measure of the ability of "something" to store electrical charge.
Arduino capacitance meter relies on the same basic property of capacitors- the time constant.
The time constant of a capacitor is defined as the time it takes for the voltage across the capacitor to reach **63.2%** of its voltage when fully charged.
Larger capacitors take longer to charge, and therefore have larger time constants. An Arduino can measure capacitance because the time a capacitor takes to charge is directly related to its capacitance by the next equation:
TC = R x C
TC is the time constant of the capacitor (in seconds).
R is the resistance of the circuit (in Ohms).
C is the capacitance of the capacitor (in Farads).

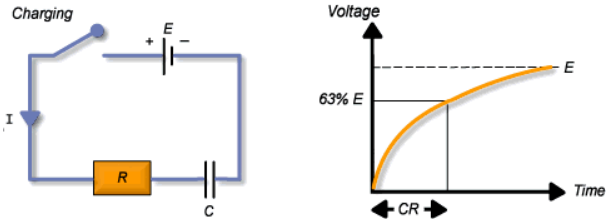

FIG.NO.2 CAPACITANCE MEASUREMENT

A. Inductance Measurement:

A typical inductance meter is nothing but a wide range LC oscillator. When measuring an inductor, the added inductance changes the oscillator's output frequency. And by calculating this frequency change, we can deduce the inductance depending on the measurement.

As we know that the frequency of LC circuit is:

f = 1/2*pi*(LC)^0.5

So we modified the above equation in that way to find unknown inductance from the circuit. Then the final version of the equation is:

L = 1/4*pi^2*f^2*C

In above equations where F is the resonating frequency, C is capacitance, and L is inductance.

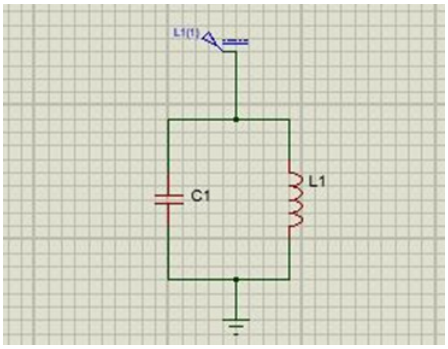

FIG.NO.3 INDUCTANCE MEASUREMENT

I. AUTO SELECTION AND AUTO RANGING

While selecting particular mode in manual ways instead of that auto selection technique is builted in the system .This process of auto selection Resistance mode, Inductancemode, and Capacitance measurement mode are done with the help of logical control relays. Auto ranging of the system R, L, and C measurement is completely done by using microcontrollers.
For measurement of Resistance R logical relay sense the property of resistance element, If it satisfy through controller relay state in same mode if condition is unsatisfied then microcontroller gives signal to relay and turns into inductor mode, same looping will continue till condition get satisfied. After receiving calculated data, it will transfer through wireless RF modules to wireless display.

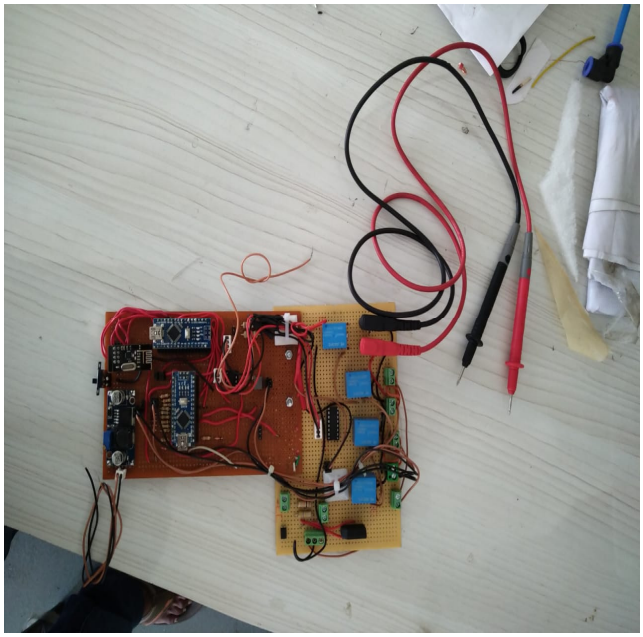

Image 1.Automatic R, L, C Measurement

Conclusion:-

By using above concept and operation the complete automatic detection and measurement of RLC can be achieved easily and in more convenient and modern way. The proper use of sensors and microcontrollers along with the protection to other components present in the circuit will be done properly. Separate R, L, C can be measured using one simple auto tool this purpose

References:-

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