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Novel Design of Buchholz Relay by Implementation of Ultrasonic Liquid Level Transducer

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ABSTRACT: Transformer is an costly and one of the most essential electrical machines. A Buchholz relay is used to observed large transformers for oil level loss or insulation breakdown. The location of relay is in an inclined pipe between the transformer and its oil conservation tank (located above the transformer). The Buchholz Relay is used as a protection purpose device having sensitivity level high to the effects of a dielectric failure inside the equipment. However, the Buchholz relay has a few disadvantages. The relay produces a tripping command during earthquakes and is expensive as well. Thus it commonly used only in the protection purpose of power transformers. This paper suggests modern and adaptive methods which are cheaper, efficient and robust. An additional advantage or benefit is the Control signal (it can be controlled directly from the control room). In this method we are implementing capacitive liquid level sensor to sense fault in transformer which having interfacing with ATMEGA328 microcontroller that will give command to relay. The main advantage of these methods is that the relays are easy to manufacture for different sizes of transformers and controlling in this method are outside the chamber containing the oil.

KEYWORDS: FSTP, Ultrasonic, harmonics, induction motor, phase generation

I.INTRODUCTION

The Buchholz relay was developed in 1921 by Max Buchholz, Oberrat (senior councilor) at PreußischeElektrizitäts-AG (Prussian electricity supply company) in Kassel. The Buchholz Relay is used as a protection purpose which is sensitive to the effects of dielectric failure inside the equipment. In Buchholz relay there is a hollow space or chamber which is placed between the main transformer tank and the conservator. When the transformer is heated or when any fault occurs, a flammable gas (DGA) is produced which tries to occupy the upper space of the chamber containing the oil. The accommodation process of the flammable gas in the upper space will be possible only when the level of transformer oil goes down. When a minor fault exist or happened then the level of transformer oil slightly goes down. When the level of oil goes down or start decreasing, the mercury switch connected to the alarm switch goes down and gets connected with the conductive hinge which is just beside the mercury switch. Alarm start ringing on completion of the circuit through conductive hinge and arcing is produced. In the same manner when a major fault occurs or happened, the level of transformer oil goes down considerably due to occupancy of a large amount of flammable air in the upper section of the chamber. simultaneously, the mercury switch connected to the trip circuit goes down. Due to this it actuates the hinge by pressure which is beside that. This results in the connection completion and activation of the trip circuit causing arcing and tripping of the transformer. Hence the above method provide protection to the transformer from Buchholz relay faults detection capabilities. In Buchholz relay, the upper part of chamber having one test cock which is used to check the quality of air produced by heating of the transformer. This helps to measure the quantity of methane, ethane and many several components by which we analyses the condition of the transformer. One



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drain valve is also available in bottom part of chamber to take out the transformer oil in case of fault condition and emergency.

However, in Buchholz relay the disadvantage is that generally it produces a trip signal in minor earthquakes and it is costly. Thus Buchholz relay is specifically used in power transformer protection. Current days automated systems are being used to control from a at one place (Control room). We estimate three methods which are cheaper than Buchholz relay. The construction of Buchholz relay is more complicated and tedious than our methods. These methods are easy to maintain , more tough and efficient. The controlling part like alarm circuit and trip circuit is always outside of the chamber which is easy to handle.Hence construction of different sizes of transformer becomes simpler.

In this method we are using capacitive liquid level sensor to sense fault in transformer which having interfacing with ATMEGA328 microcontroller that will give command to relay circuit . The prominent advantage of these methods is that the relays are simple to manufacture for different sizes of transformers and controlling in all these three methods are outside the chamber containing the oil & which is very cost effective.

II. DESIGN COMPONENTS OF BUCHHOLZ RELAY

Ultrasonic transducers convert AC signal into ultrasound signal & vice versa. Ultrasonic, specifically refers to piezoelectric transducers or alternatively capacitive transducers. Piezoelectric crystals change structure and shape when a voltage is connected ; AC voltage makes them vibrate at the same frequency and generate ultrasonic sound. Capacitive sensor or transducer use electrostatic fields between a conductive diaphragm and plate. The beam pattern of a transducer can be explained by the active transducer surface and shape & size, the ultrasound wavelength produce by sensor , and the sound velocity of the propagation medium. The diagram represent the sound fields of an unfocused and a focusing ultrasonic transducer in oil, plainly at differing energy band. Piezoelectric materials producing a voltage when force is indulge to them, they can also work as ultrasonic finder. Few systems use separate transmitters signals and receivers, while others combine both functions into a single piezoelectric transceiver. Ultrasound transmitters can also use non-piezoelectric principles to produce signal. such as magnetostriction. Materials with this property change size slightly when exposed to a magnetic field, and make practical purpose transducers.

A capacitor microphone has a thin diaphragm that react to ultrasound waves. Variation in the electric field between the diaphragm and a closely spaced backing plate convert sound signals method to electric currents, which can be amplified.

III. ARCHITECTURE BUCHHOLZ RELAY

Sound waves are having specific frequencies range or number of oscillations per second.. However the frequency range normally utilized in ultrasonic detection is 100 KHz to 50MHz. The velocity of ultrasound at a specific time and temperature is constant in a medium or condition.

$$W = C/F \text{ (or) } W = CT$$

Where W = Wave length

C = Velocity of sound in a medium

F = Frequency of wave

T=Time Period

The most common implemented methods of ultrasonic examination utilize either longitudinal waves or shear waves. The longitudinal wave is a compression waveform in that the particle motion is in the same direction of the propagation wave. The shear wave is a wave motion in that the particle motion is perpendicular to the direction of propagation or direction of traversal. Ultrasonic detection introduces high frequency sound waves into a test object to



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obtain information about the object without changing or affecting it in any manner. Two different values are measured in ultrasonic detection process.

The amount of time, taking for the sound to travel through the medium and amplitude of the received signal. Based on velocity and time thickness can be calculated.

$$\text{Thickness of material} = \text{Material sound velocity} \times \text{Time of Flight}$$

Transducers for Wave Propagation and particle detection

For sending signal of sound waves and receiving echo or return sound, ultrasonic sensors, commonly called transceivers will be used. They work according to a principle resemble to radar technique that will convert electrical energy into mechanical energy in the form of sound wave, and vice versa in manner. The frequently used transducers are contact transducers, angle beam transducers, delay line transducers, immersion transducers, and dual element transducers for different purpose. Contact transducers are typically used for locating hollow space and cracks to the outside surface of a part as well as measuring thickness level. Angle beam transducers use the principle of reflection and mode conversion to produce refracted shear or longitudinal waves in the material under test.

Delay line transducers are single proceeding element longitudinal wave transducers used in conjunction with a replaceable delay line. Main reasons for choosing delay line transducer is that near surface of resolution capable to improved. The delay allows the element to stop vibrating before a return signal from the reflector can be received. The major advantages offered by immersion transducers over contact transducers are Uniform coupling reduces sensitivity variations, Reduction in scanning time, and increases sensitivity or ability to respond to small reflectors.

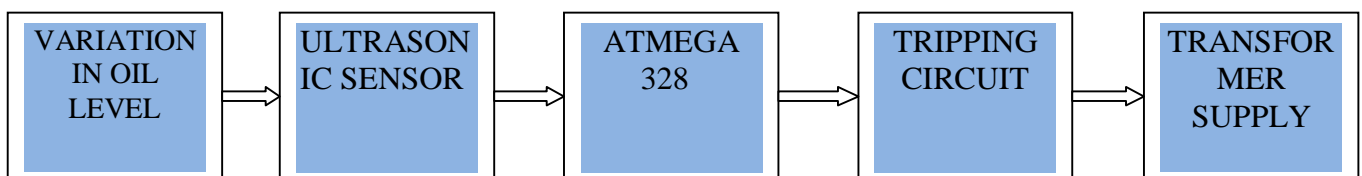


Fig. 1 Buchholz relay Block Diagram

IV. INTERFACING WITH 8051 MICROCONTROLLER

The Atmel 8-bit AVR RISC-based microcontroller combines 32 kB ISP flash memory with read-while-write capabilities are very accurate, 1 kB EEPROM, 2 kB SRAM, 23 general purpose I/O lines, 32 general purpose working registers to store values, three flexible timer/counters with compare modes precise time commands, internal and external interrupts for signal, serial programmable USART, a byte-oriented 2-wire serial interface utilized to data transmission, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts range. The device capable throughput approaching 1 MIPS per MHzP

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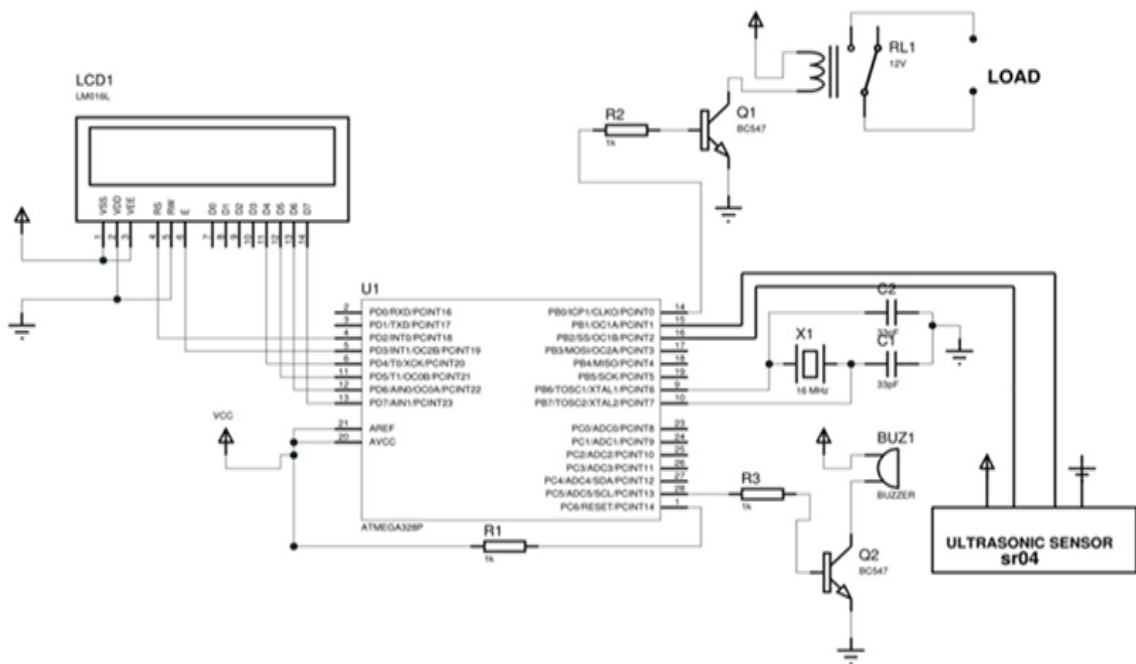


Fig.2 Interfacing diagram of novel design of buchholzrealy Block Diagram of ATMEGA328Microcontroller

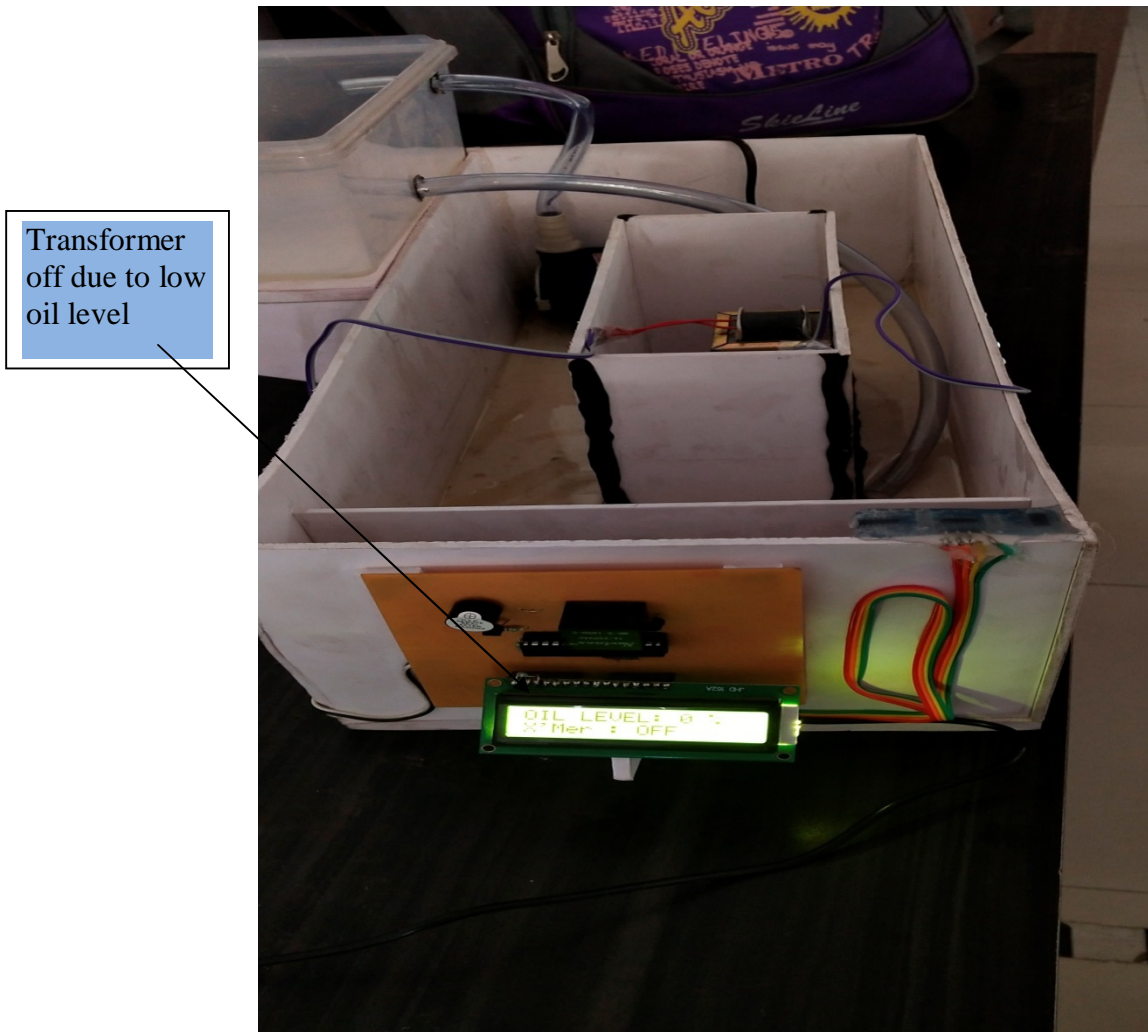


Fig.3 Construction of actual buchholz relay by using ATMEGA328 Microcontroller

V. CONCLUSION

In proposed system we are providing an alternative & novel design for traditional buchholz relay by designing on whole new conceptual idea & method. Traditional buchholz relay only implemented for power transformer but our relay system can be implemented for transformer having lower rating. This method is very cost effective method & sensitivity level of relay is much more as compared to conventional relay.

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