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Designing Temperature Control System to Reduce Energy Consumption in Buildings

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ABSTRACT

The device is a temperature control system that can be used to control the heat of many household appliances has been applied and obtained results in the cases of iron and domestic water heater.

Through this system, the control was replaced by an on-off thermostat. In this case, the maximum power of the device is in the case of 1-ON and 0-OFF in the case of separation.

This system has been replaced with a contnious system that controls the energy to be compensated to compensate for the loss only, which depends on the conditions of the external medium and therefore there is no need to drag the maximum energy to maintain the output, which is the temperature at a specified value.

This new system achieved energy savings ranging from (32-80%) depending on the state of the external medium (medium temperature for the iron and water - water consumption - moisture degree of clothing for the iron).

Keywords:- Temperature Control

I. INTRODUCTION

Why was the construction sector selected?

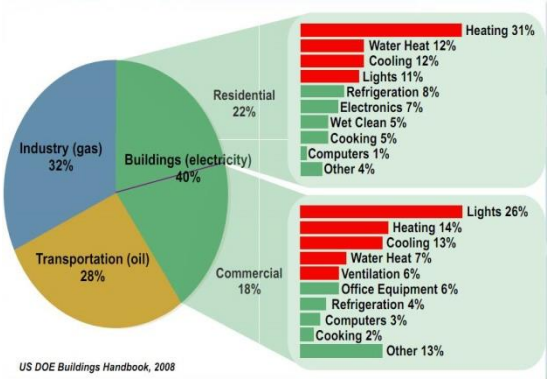


Figure 1 Energy consumption diagram of building

Figure (1) shows that energy consumption in buildings is about 40% of the total consumption value and the buildings are divided into residential buildings and commercial offices [1]. The figure also shows that energy consumption in refrigeration and air conditioning equipment takes the largest proportion of consumption. Hence, it was necessary to select some electrical equipment, study the principle of its working state and work on designing energy-saving control systems in these equipments, And has been taking the irons and study on it.

II. HOW DOES THE IRONS WORK AND WHAT ARE THE HEAT CURVES AND THEIR ABILITY?

The following figure shows the circuit diagram of the iron [3]:

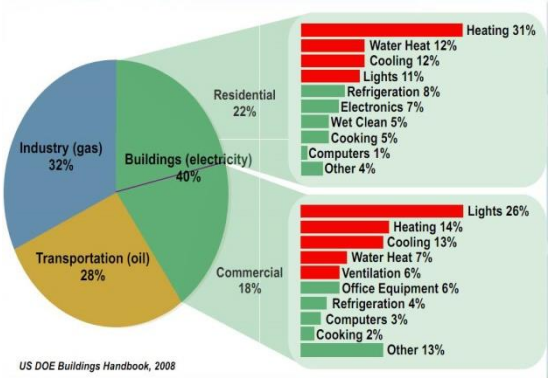


Figure 2 Electrical circuit of the iron

The results of tests on the machine were as follows:

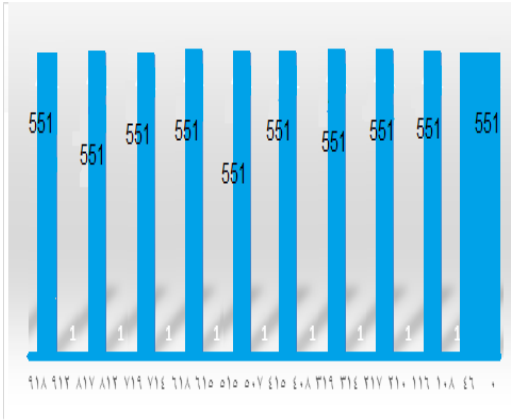


Figure 3:Curved capacity

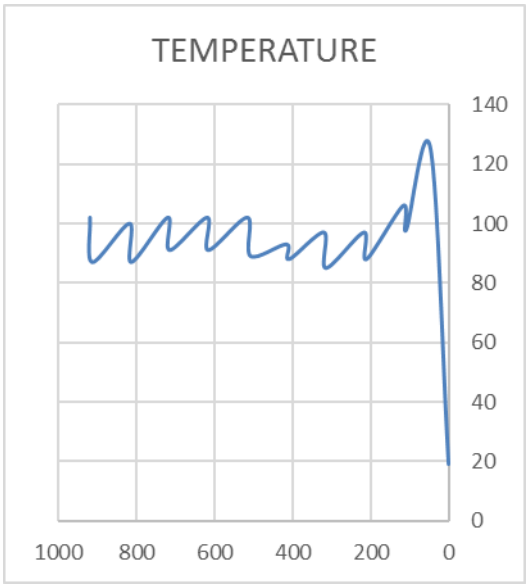


Figure 4: Curved heat

From the curves in Figure 3 and Figure 4, the time of separation and connection of the iron varies according to the surrounding
ambient conditions, and each time the iron takes the full capacity necessary for its operation, the consumption is therefore large.
From here ,we came up with a control system that achieves temperature stability with less energy consumption (we only give the needed energy to compensate heat loss caused by the work of the equipment which is due to loss.

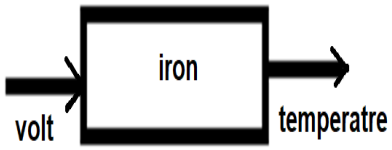


Figure 5 Iron circuit

III. DESIGNING CONTROL SYSTEM [5]

In this research we did the following:
• The temperature control system was designed for various electrical equipment.
• The electrical equipment was modified as we removed the (on-off)digital controls and replaced them with the temperature control system circuit .
• Actual temperatures were measured by temperature sensors before and after using the control circuit.
• The temperature difference between the reference temperature and the temperature measured by the sensor, was calculated and sent to a precise controller that uses a reverse feeding signal. The smaller the difference, the less effort voltage.
• The system has been tested on several equipment (1000W electric jug - 2500W electric heater - 2500W washing machine - 600W iron). The results were compared with a similar process using digital control.
The feedback and power control system designed for electrical equipment consists of:
• Zero-pass detection circuit
• Temperature sensors
• Microcontroller (Arduino uno)
• TRIAC and associated circuits
• The electrical equipment to be controlled with, and study energy saving on Figures 6 and 7, respectively, show a diagram of the circuit, a feedback form, and the power control system

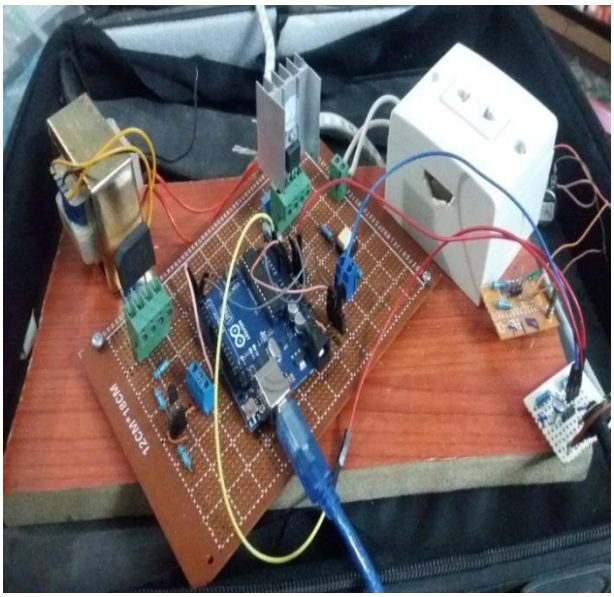
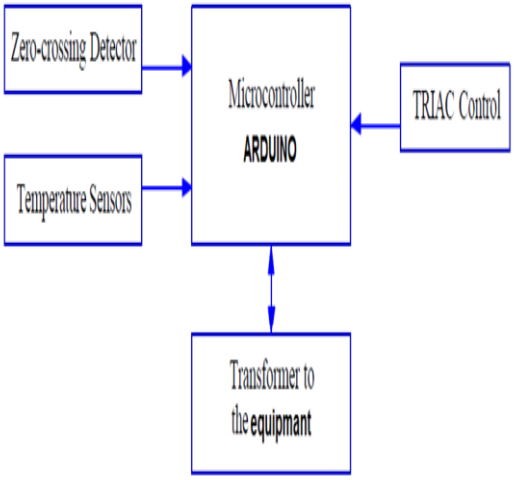


Figure 6: Process circuit.



Figures 6: diagram of the circuit

IV. ZERO-CROSSING DETECTION CIRCUITS

A zero-crossing detection circuit was developed to provide trigger signals — a pulse train to the microcontroller for a phase -control of the heater (Figure 7). The zero-crossing detection circuit consisted of:

• Adapter to reduce voltage.

• Full-wave rectifier. In each cycle of the sine wave, there are two zero crossing points: one occurs when the signal changes from negative to positive, and the other from positive to negative.

• R1-R2 is used to protect the transistor from high currents.

• Transistor.

The output signal enters the microcontroller. The signal emerging from the zero-transit circuit is wide pulses at a frequency of 50 Hz. The voltage source must be the same as the main transformer source; otherwise the phase shift may occur to affect the accuracy of the control.

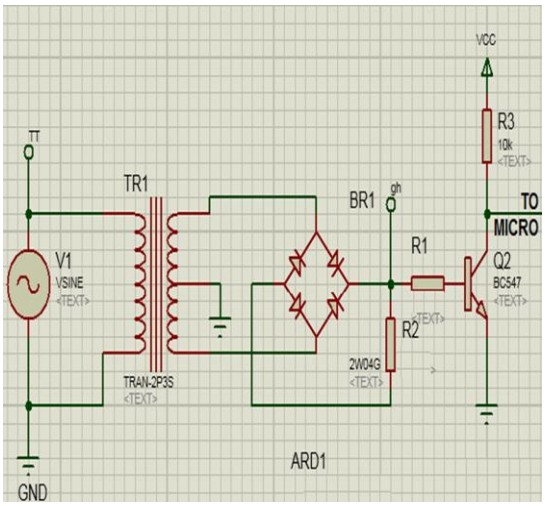


Figure 8: zero-crossing detecting circuit

V. TRIAC CONTROL CIRCUIT

A power TRIAC (Q4025L6-ND, Teccor Electronics Inc., Des Plaines, IL, U.S.A) was used to control the AC source (120V, 60Hz), . The TRIAC was wired to the low-voltage side (the primary coil) of the high-voltage transformer.

To conduct the reverse current that may occur in the TRIAC during the power-off period, an RC circuit was installed in parallel with the anode-cathode of the TRIAC (Fig. 9(.

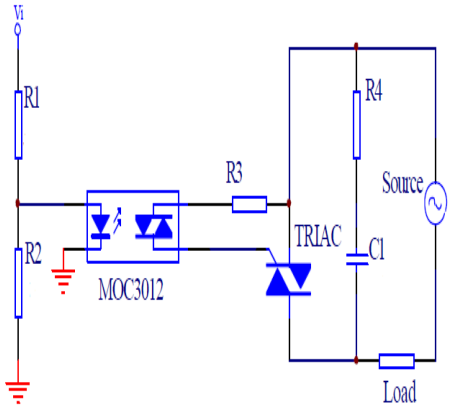


Figure 9: Triac output circuit to control loads

A MOC3012 opto-coupler was used as a high voltage isolator to protect the microcontroller>

R1 was used to load majority of the +5V of the signal to protect the MOC3012; R2 was used to dissipate the reverse current to speed up the reaction time of the MOC3012.

R2 must be much larger than R1 to ensure that most of the input voltage Vi is directed to the MOC3012..

In phase control, after each zero-crossing point, the power was cut away at a “delay” angle (in time) and then conducted for a “conduction” angle (in time) (Figure10). magnetron. time.

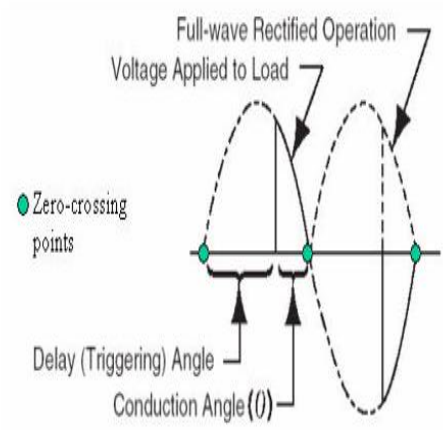


Figure 10 Concept of phase control (Courtesy: Teccor Electronics Inc.(

VI. RESULTS OF TESTS WITH A CONTROL SYSTEM

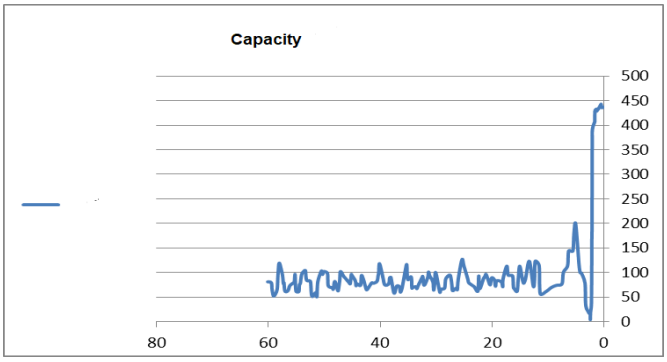


Figure 11: Power curve of the circuit with control system

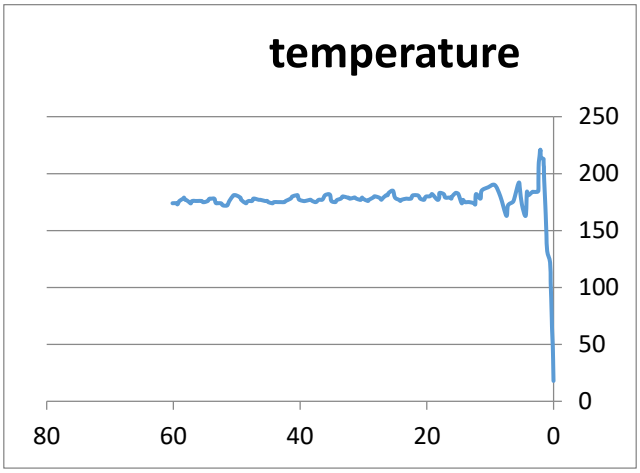


Figure 12: curved heat circuit with a control system

VII. COMPARISON RESULTS

$\frac{Tv}{T}$	10 %	20 %	30 %	40 %	60 %	80 %	90 %
W(wh) Without control	50	100	150	200	300	400	5000
W(wh) With control	65	68	71	74	77	81	84

Table1 : Comparison of results in case of different degree of application of the role

From the previous table, we find that the capacity after adding the feedback to the iron, and replacing it with thermal heat resistance and microcontroller circuit has decreased significantly with changing conditions of the medium.

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