CONTROL FOR HEATING OBJECTS USING A MICROCONTROLLER

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ABSTRACT

The PID regulator is widely applied and popular because of its simple and easy-to-apply control algorithm. Along with the development of science and technology, digital is used in many fields, one of which is applied to the Digital PID regulator. In this paper, a microcontroller is used to adjust the temperature of the heating object. With the digital PID control algorithm, it will be loaded into the microcontroller to improve the quality of the Heating object.

Keywords: *PI, PID, Heating object.*

1. INTRODUCTION

Traditional heating systems often use analog systems. The weakness of this system is that they are sensitive to changes in noise and component life, and it isn't accessible to upgrade and expand the system. Therefore, digital control structures overcome all the above disadvantages by using programmable microprocessors and glorifying made by software. High-speed digital signal processors allow us to perform numerical control problems requiring high resolution, speed, and extensive computation.

2. CONTROL DESIGN

We will consider the following closed-loop system control structure

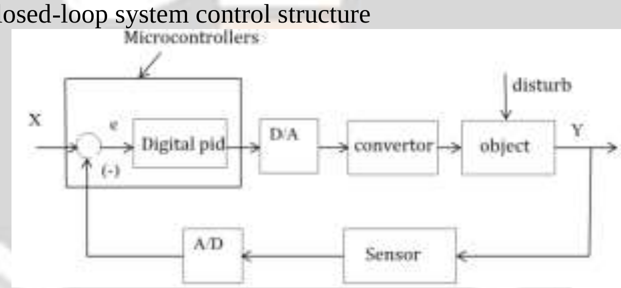

Fig -1 Structure of the control system

The digital PID regulator has the following algorithm:

With:

$$u_{ref}(t) = K_P\, e(t) + K_I \int e(t)dt + K_D \frac{de(t)}{dt} \quad (1)$$

$$W(s) = \frac{U_{ref}(s)}{E(s)} = K_P + \frac{K_I}{s} + K_D.s = K_P(1 + \frac{1}{T_I s} + T_D.s) \quad (2)$$

$$T_I = \frac{K_p}{K_I}\ ; \quad T_D = \frac{K_D}{K_P} \quad (3)$$

The difference equation of the PID regulator:

$$u_{ref}(t) = u_p(t) + u_I(t) + u_D(t)$$

Switching to differential equations:

$$u_p(t) = K_p e(t); \qquad u_p(k) = K_p e(k); \qquad u_I(t) = K_p \frac{1}{T_I}\int e(t)dt;$$

$$u_I(k) = K_p \frac{1}{T_I}\frac{T}{2}\left[e(k)+e(k-1)\right] \; u_D(t) = K_p T_D \frac{d\,e(t)}{dt};$$

$$u_D(k) = K_p T_D \frac{\left[e(k)-e(k-1)\right]}{T} = K_p T_D \frac{1}{T}\left[e(k)-e(k-1)\right]$$

$$u_{ref}(k) = K_p\, e(k) + K_p \frac{0.5T}{T_I}\left[e(k)+e(k-1)\right] + K_p T_D \frac{1}{T}\left[e(k)-e(k-1)\right]$$

3. EXPERIMENTAL RESULTS

Experimental results are obtained when installing with a PID regulator. Set PID regulator parameter to K_p =6; K_i = 0,015; K_d = 0. In order to clearly observe the changing process of the control voltage, the changing temperature.

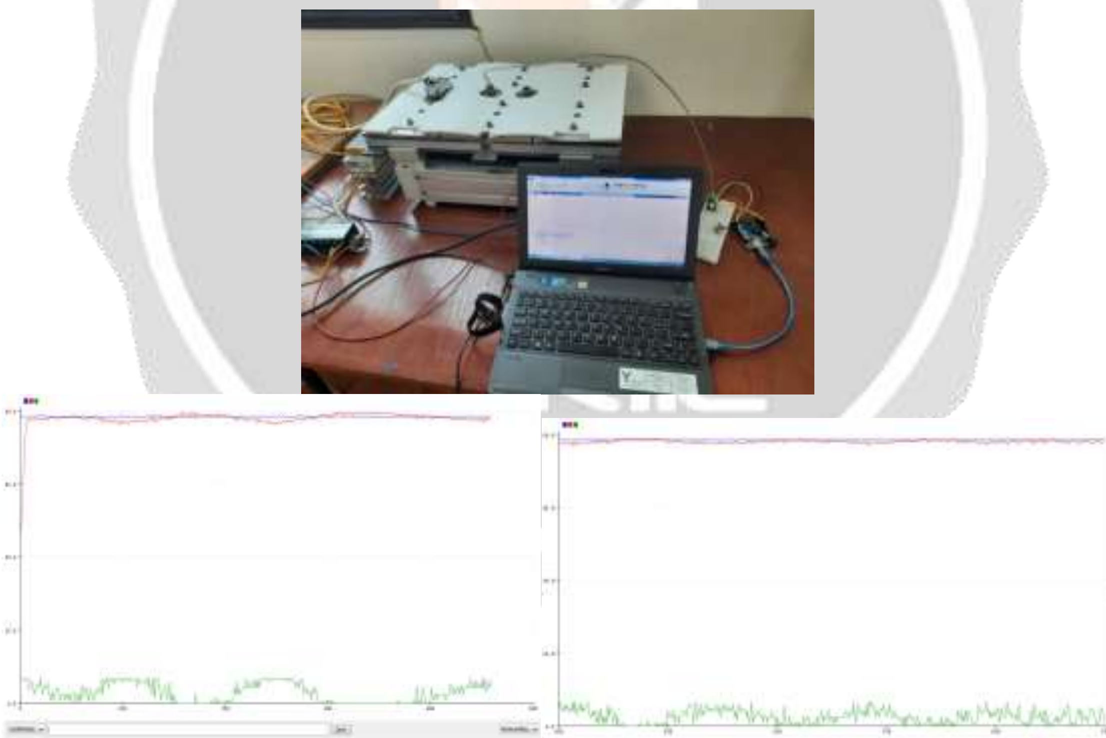

Fig -2 Experimental system for temperature control

The heater experimental object as shown in Figure 2 requires that the temperature can be adjusted from 0-100oC. We can see that the temperature quickly returns to the set temperature, proving that the controller design meets the requirements.

4. CONCLUSIONS

In this study, the control structure according to the PID method has been implemented for the temperature control system. We see that the system has met the requirements set forth when using a microcontroller to control the heating object with a temperature feedback control structure and a digital PID regulator.

5. ACKNOWLEDGEMENT

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