

**UNIVERSITI TEKNOLOGI MARA
CAWANGAN PULAU PINANG**

**APPLICATION OF SELF-TUNING FUZZY PID
CONTROLLER ON INDUSTRIAL ESSENTIAL
OIL EXTRACTION SYSTEM USING SYSTEM
IDENTIFICATION APPROACH**

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

The essential oil extraction process is that is deeply influence by temperature, therefore, precise management is essential to optimize production and maintain the quality. The nonlinear and dynamic characteristics of this process provide considerable hurdles for conventional control systems such as PID controllers, which are constrained by their fixed-parameter configurations. This research tackles these issues by formulating an Autoregressive Exogenous (ARX) model to depict system dynamics. Then the PID and the Self-Tuning Fuzzy PID (STFPID) was then developed. Thus, both controllers were then evaluated and compared to identify the best controller that can be to improve control efficacy. The ARX model was verified via MATLAB Simulink, achieving a best-fit percentage of 91.02%, an FPE of 0.01291, and an MSE of 0.01287, so confirming its accuracy and dependability. The PID controller, however proficient in ensuring stability, had prolonged reaction times, characterized by a rising time of 800.51 seconds and a settling time of 1377.1 seconds. The STFPID controller utilized fuzzy logic to dynamically modify its settings, resulting in a notable increase in performance. The optimal outcomes were attained using the seven-level triangular membership function, which decreased the rising time to 323.54 seconds and the settling time to 649.31 seconds, with no overshoot. The results demonstrate the superiority of the STFPID controller in regulating the nonlinear dynamics of the essential oil extraction process, guaranteeing accurate temperature control, and improving efficiency. This study offers a comprehensive framework for the incorporation of modern control methodologies in industrial applications, enhancing product quality and operational efficiency.

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