Performance Comparison of Microcontroller-Based Optimum Controller for Fruit Drying System

Authors : Umar Salisu

Abstract : This research presents the development of a hot air tomatoes drying system. To provide a more efficient and continuous temperature control, microcontroller-based optimal controller was developed. The system is based on a power control principle to achieve smooth power variations depending on a feedback temperature signal of the process. An LM35 temperature sensor and LM399 differential comparator were used to measure the temperature. The mathematical model of the system was developed and the optimal controller was designed and simulated and compared with the PID controller transient response. A controlled environment suitable for fruit drying is developed within a closed chamber and is a three step process. First, the infrared light is used internally to preheated the fruit to speedily remove the water content inside the fruit for fast drying. Second, hot air of a specified temperature is blown inside the chamber to maintain the humidity below a specified level and exhaust the humid air of the chamber. Third, the microcontroller disconnects the power to the chamber after the moisture content of the fruits is removed to minimal. Experiments were conducted with 1kg of fresh tomatoes at three different temperatures (40, 50 and 60 °C) at constant relative humidity of 30%RH. The results obtained indicate that the system is significantly reducing the drying time without affecting the quality of the fruits. In the context of temperature control, the results obtained showed that the response of the optimal controller has zero overshoot whereas the PID controller response overshoots to about 30% of the set-point. Another performance metric used is the rising time; the optimal controller rose without any delay while the PID controller delayed for more than 50s. It can be argued that the optimal controller performance is preferable than that of the PID controller since it does not overshoot and it starts in good time.

Keywords : drying, microcontroller, optimum controller, PID controller
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