

DESIGN AND DEVELOPMENT OF A COCOA BEAN DRYING SYSTEM USING PID CONTROL METHOD

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ABSTRACT

Chocolate is a high-value commodity with increasing global demand. The cocoa bean drying process is a crucial stage to preserve flavor and aroma quality as well as to prevent damage caused by excessive moisture. Manual drying methods are still widely used but are inefficient and require intensive labor. This study designs an automatic cocoa bean drying system based on an Arduino microcontroller with a temperature controller using the Proportional Integral Derivative (PID) method. The system is equipped with temperature and humidity sensors to maintain drying conditions according to the specified parameters. Test results show that the system is capable of drying cocoa beans within approximately 180 minutes, maintaining temperature stability in the range of 55,00 °C – 55,40 °C with a steady-state error of less than 1 %. The drying process successfully reduced humidity from 75 % to 40 %, meeting the cocoa bean quality standard. Compared to manual sun-drying methods, which require 5–7 days and are weather-dependent, this system is significantly more efficient and reliable. Future improvements are recommended by integrating higher-accuracy temperature sensors, more stable heating elements, and adding a buzzer or wireless communication module as an end-of-process indicator.

Keywords: *Dryer, cocoa beans, Arduino, temperature, humidity*