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Smart power management for improved energy performance of an inflatable solar dryer

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Post-harvest losses are an important factor that influence the production cycle of many crops. Research is required to support initiatives which improve processing and storage, since inadequate technologies, improper practices and lack of knowledge are currently causing considerable qualitative and quantitative post-harvest losses. Drying is a critical post-harvest process during which the end product can be significantly affected. Sun drying is commonly practiced in tropical regions, despite leading to higher losses. As an alternative, an innovative solar drying technology has been developed. The Inflatable Solar Dryer (ISD), a further development of the solar tunnel dryer Hohenheim type, is made out of plastic films and is inflated using two ventilators. The ISD does not need any solid structure as the ventilators inflate the dryer forming a tunnel, thus it is collapsible and can easily be transported. The ventilators are driven by a photovoltaic system for off-grid operation. Further improvement on the power system/ventilators was required to optimize the energy consumption accordingly as drying is performed. Digital implementation presents a possibility to control and monitor processes via proportional integral derivative controller (PID). These controllers are commonly used in many applications to reduce costs, time and to better handle energy supply/consumption. A PID control with digital signals was developed to manage the energy consumption of the ventilators in the ISD, lowering the energy consumption. The regulation system used a micro-controller, which read analog signals from temperature and relative humidity sensors integrated in the ISD. Output signal was transformed to digital signals in order to adjust the speed of the ventilators based on the control signal. The principle relays in controlling the ventilators via pulse width modulation (PWM). The interface has been written using wiring-language in Arduino software. To investigate and demonstrate the effectiveness of the proposed approach, the PID controller is presented together with initial results.

Keywords: solar dryer, automatization, PID control, energy efficiency.