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Inexpensive Open Source Hardware Probing To Stream Thermal Changes in Food Processing

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Abstract

Live monitoring and streaming of physical changes in correlation to chemical changes in food related research are observed as a new trend. This is more implementable with the emerging of open source hardware platforms, i.e. Arduino, that enables probing in simple manner. This will also lead to innovative design of smart equipments for monitoring and controlling in small and medium scale food industry since the platform is inexpensive. This preliminary research was aimed to utilize Arduino and thermal sensors to monitor various types of food processing. The method included sensor calibration, data acquisition, software smoothing, and application to steaming, oven-drying, sun-drying, and frying. Calibration was conducted by comparing each electronic sensor reading with a mercury thermometer to measure 0-100°C of 2L water, and then the interpolated function was applied to data acquisition. To reduce the effect of noise, data smoothing was applied by incorporating cumulative average, binary exponential moving average, and average of modes, which the results were compared to single readings. The applications of sensors were (1) waterproofed negative thermal changes (NTC)-thermistor for steaming operation, (2) K-type thermocouple for frying, (3) digital humidity and temperature type 11 (DHT-11) for sun-drying, and (4) LM-35 for oven heating. Sensor calibration results in polynomial functions which are specific to each sensor. Sensors were more sensitive (<1min) to increase than to decrease in temperature, i.e. 170°C of frying oil can be read after ±10s of K-type thermocouple contact, while it required ±1 min to read 0°C, down from room temperature (24°C). Arduino provided ability to stream thermal changes in food processes at a resolution of three sec/reading after data smoothing was in effect. This shows Arduino platform as a simple, inexpensive, and reliable tool. The future experiment may include live monitoring of chemical changes by incorporating different sensors.

Keywords: Arduino, thermal sensors, food processing, data acquisition, streaming.