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便携式生鲜肉品质无损快速检测装置的设计

Design of portable device for rapid nondestructive detection of fresh meat quality

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中文摘要:

针对生鲜肉检测部门对可移动、便携式检测设备的实际需求, 设计了基于ARM处理器便携式生鲜肉品质无损快速检测装置。介绍了该装置的工作原理、硬件构成、系统和功能测试。硬件系统由ARM控制处理单元、光源及检测单元、光谱数据采集单元、LCD触摸屏显示单元和散热单元组成, 设计了Linux操作系统和生鲜肉品质参数采集处理应用程序。该系统可实现脱离计算机采集光谱信号、存储、显示及处理分析一体化的功能。该装置体积为184 mm×127 mm×114 mm, 装置质量约为3.5 kg。以批品验证装置检测精度, 试验结果表明, 颜色L*、a*、b* 3个参数的均方根误差分别为1.49、1.09和0.59, 平均检测一个样品时间约为1 s。该装置可以快速获得样品参数, 体积小、便携、无损伤、快速检测的特点, 可用于生鲜肉品质的便携式检测。

英文摘要:

Abstract: Quality of fresh meat affects the health of consumers and also receives much attention from government and industry. Recent years' study shows that visible and near infrared reflectance spectroscopy (VIS-NIRS) was applied to fast and non-invasively detect meat's quality factors which include water content, tenderness, pH value, TVB-N and so on. Inspection departments have created the need for a cost-effective and nondestructive quality-control analysis system. But the traditional detection system consist of spectrograph, illuminant, optical fiber, computer and dark box which cannot be moved and operated easily, so it has not been widely used.. Portable detection devices are powerful instruments offering several advantages for nondestructive, online analysis: small size, low cost, robustness, sample user interface, portability, and ergonomic design. Domestic and abroad scholars have developed portable spectrometers to detect internal and external parameters of fruits and vegetables, but characterization of meat parameters is still needed. In order to meet the demand of inspection departments for portable devices, a rapid and nondestructive detection device for fresh meat quality based on ARM (advanced RISC machines) processor was designed. Working principal, hardware composition, software system and functional test were introduced. The hardware system consisted of ARM processing unit, light source and detection unit, spectral data acquisition unit, LCD (liquid crystal display) touch screen display unit and the cooling unit. Linux operating system and quality parameters acquisition processing application were designed. In this paper, ARM processor was applied to collect spectrum data, to control the serial port, to process data, and to export results on LCD. ARM processor received spectral data via the serial port from Micro spectrometer. A halogen lamp was used as a light source because of its wide spectrum range. USB4000 spectrograph was selected as the collecting spectrum unit due to its small size and high-performance. In order to transmit optical signals, there was a coupling lens fixed in front of the USB4000's slit. As the object of detection is meat, it is easy to contaminate the probe by blood, so an optical window was set between the meat and the probe. To software, the C++ language was used to compile to achieve offering a friendly user interface. Users can get values of the meat's parameter from the LCD. This system has realized collecting spectral signal, storing, displaying and processing as integration with the weight of 3.5 kg and volume of 184 mm×127 mm×114 mm. 76 pieces of meat were used in the experiment to validate the stability and reliability. The experimental results show that this device can be used for portable detection of meat quality with small volume and the advantage of being portable, with no damage and being fast.

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