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COMPUTER VISION CLASSIFICATION OF POTATO CHIPS

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ABSTRACT: In this research we studied the automatic classification of potato chips by computer vision. The general objective was to design a tool which would be able to classify potato chips according to their color in categories. For this purpose, sensorial measurements of color in potato chips were correlated with the corresponding objective measurements obtained with a computer vision system. Potato chips with and without ruffles of different brands were used for training and validation experiments. Sensorial evaluations were done with a special chart which classifies potato chips in seven color categories. Simultaneously, the color of the same potato chips analyzed by the sensorial panel was determined by a computer vision system in L*a*b* units. Then, a linear regression model demonstrated that was good enough to predict color potato chips sensorial values from the corresponding instrumental color measurements. The linear model after following the process of crossed validation crossed presented an error of ~4 for smooth chips and 6.8 % for chips with ruffles.
KEYWORDS: potato chips, color, computer vision, automatic classification.

INTRODUCTION: Potato chips have been popular salty snacks for 150 years and its retail sales in US are about $6 billion/year representing 33% of the total sales of this market (Garayo and Moreira, 2002; Clark, 2003). In the potato chip industry, each batch of potato tubers must be tested for quality before processing, and the visual aspect is of great importance (Marique at al., 2005). Color of potato chips is the first quality parameter evaluated by consumers and is critical in the acceptance of the product (Pedreschi et al., 2006). Consumers tend to associate colour with flavour, safety, storage time, nutrition and level of satisfaction due to the fact that colour correlates well with physical, chemical and sensorial evaluations of food quality. Important aspects such as surface color and appearance can be studied successfully using computer vision techniques to determine potato chip quality. In European factories, some computer vision systems are used for the on-line evaluation of potato chips, allowing chips to be sorted according to defects like black spots or blisters. In this paper we studied the automatic classification of potato chips by color using by computer vision.

METHODOLOGY: Smooth and undulated (with ruffles) potato commercial chips of different brands were used in the experiments. Sensorial color analyses of potato chips was accomplished by sensorial panel formed by eleven people previously selected according to their ability to clearly distinguish among different colors. Each trained member of the panel analyzed the color of potato chips using the color and intensity scale observed in chart presented in figure 1.

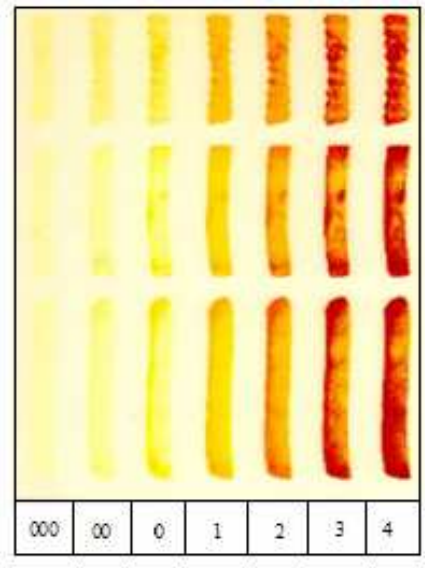

FIGURE 1. Color chart for sensorial analysis of commercial potato chips.

The corresponding instrumental measurements of color in RGB units of the evaluated sensorial evaluated potato chips were performed in a computer vision system implemented by Pedreschi et al. (2006). For converting the color in RGB units to Lab units a routine developed in Matlab code and developed by León et al. (2006) was used. The schematic representation of the computer vision system used in this research is presented in Figure 2.

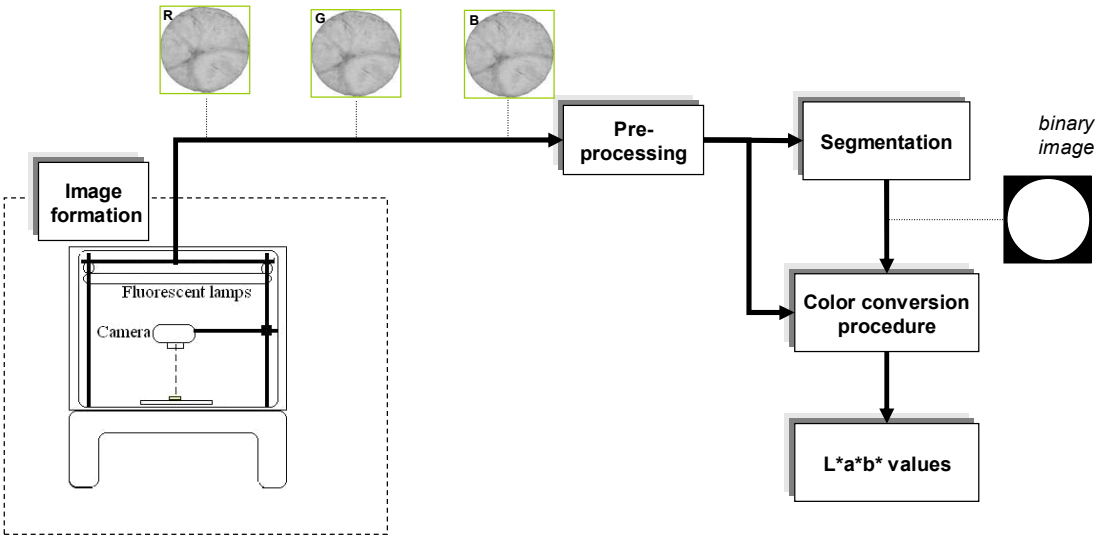

FIGURE 2. Schematic representation of the computer vision system used for color conversion process from RGB images to *L*a*b** units.

For each type of potato chip, 100 samples were used (80 in the training step and 20 for the validation step). In order to develop the lineal model, a simple regression analysis was implemented and the errors were calculated. Finally, a cross validation procedure step was implemented in order to test the performance of the developed model.

RESULTS AND DISCUSSION:

Sensorial color values were estimated properly by the lineal model determined previously with an approximate error of 4%.

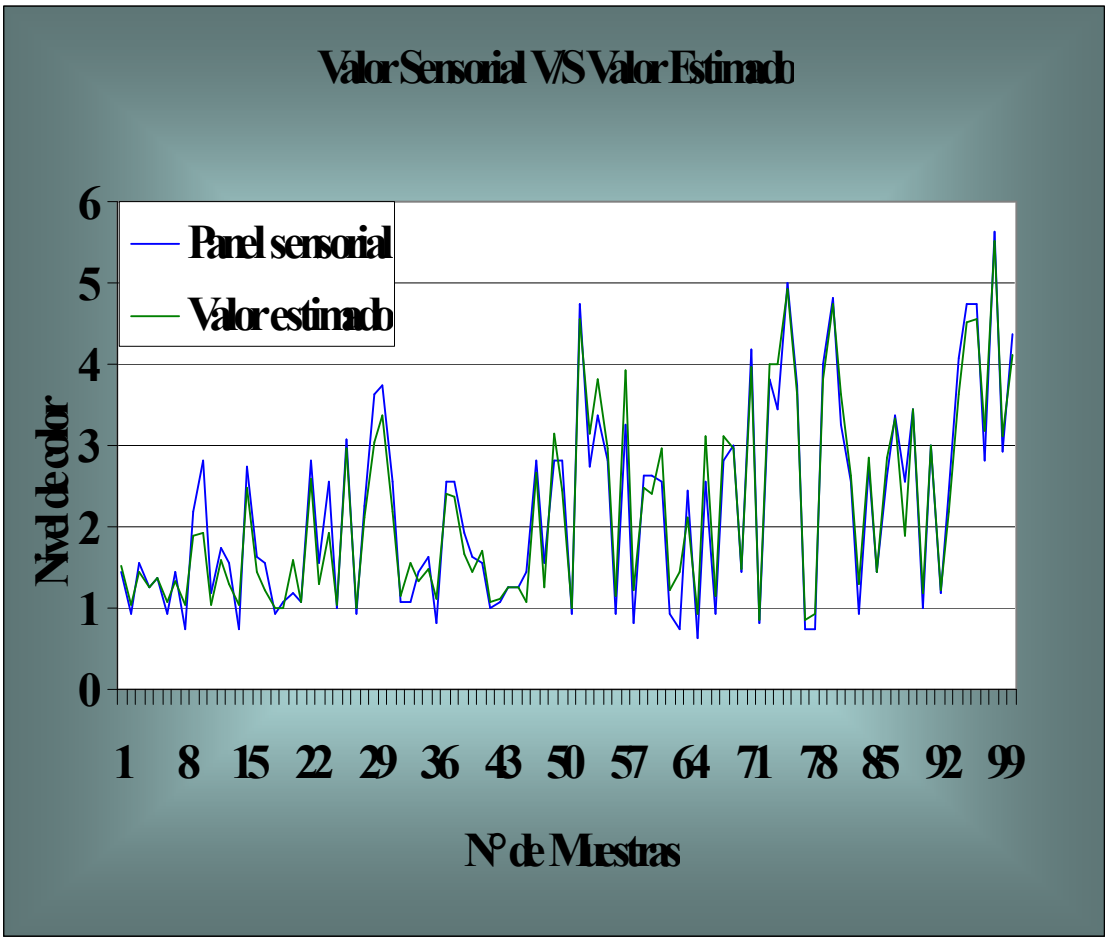

FIGURE 3. Comparative plot for color sensory measured *vs.* color estimated by the model for potato chips without ruffles.

Figure 3 show the differences between sensorial color values and estimated color values per each analyzed simple. Both curves are very similar and the differences are not significant indicating that the lineal model could used properly to predict accurately the color of potato chips.

CONCLUSION: An automatic classifier to group potato chips in categories according their color was implemented successfully (error of the lineal model was ~ 4%). There was a high correlation between sensorial measurements of color of potato chips and those corresponding determined by computer vision.

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