Genetic Parameter Tuning for Reliable Segmentation of Colored Visual Tags

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ABSTRACT

This paper reports on a case study on segmentation of colored visual tags for object identification. Lighting variations result in uncertainty in color thresholds leading to unreliable overall system behavior. We describe an experiment with a genetic algorithm (GA) approach for generating reliable thresholds for color identification. We compare it with a maximum distance (MD) approach, and demonstrate that the genetic approach is far more accurate and reliable.

Categories and Subject Descriptors

H.5.2 [**Information Interfaces and Presentation**]: User Interfaces – *input devices and strategies, interaction styles.*

General Terms

Reliability, Experimentation, Human Factors.

Keywords

Visual Tags, Genetic Algorithms, Color Segmentation, Parameter Approximation.

1. INTRODUCTION

Researchers have long recognized the inadequacy of the traditional modes of interaction, namely keyboard and mouse. One answer to this problem is to equip computers with the ability to "see" their input, so that there is minimal effort on the part of the user in providing this input. An implementation of this idea has taken the form of visual tags, which are usually black and white. Color, an extremely valuable descriptor, is often shunned due to increased uncertainty. We report on our experiments with color tags using two approaches, MD and GA. Our tests indicate that the GA approach produces reliable thresholds.

2. EXPERIMENTAL RESULTS

Our color barcode [1] encodes a numeric value. The problem is in the difficulty in discovering the right thresholds to be used in segmenting the colors in variable lighting. In the MD approach, we clicked on a color several times and averaged the readings. Similarity included any shade within the range between the average color and the sampled pixel farthest from this average. In the GA approach, we used GA Playground (http://www.aridolan.com/ga/gaa/gaa.html) to produce thresholds. The average color mentioned above was used as the target color. Initial thresholds were generated randomly (hence full automation is possible if the target color is available). These were used to read tags encoding known values, and new thresholds were generated following standard GA protocol. A hundred iterations sufficed. Fitness was based on how close (as per Hamming distance) readings made using GA-generated thresholds were to the known encoded values.

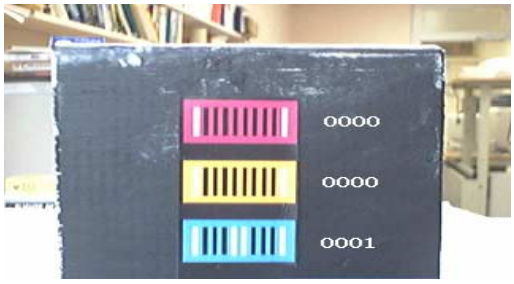

Figure 1. Color Barcodes.

The image shown in Figure 1 was used in this experiment. Parameters obtained by the GA and MD approaches were applied 9 times to different pixel samples (i.e. each tag was sampled three times). As Table 1 shows, the GA approach was correct 100% of the time. Assessment of results for the MD approach (11% correct) is more involved and is left for future work.

Table 1. Comparison by Hamming Distance

Value	0	0	1	0	0	1	0	0	1
MD	0	1	0	0	8	5	4	14	8
MD Dist	0	1	1	0	1	1	1	3	2
GA	0	0	1	0	0	1	0	0	1
GA Dist	0	0	0	0	0	0	0	0	0

3. REFERENCE

[1] Mbogho, A.J.W. and Scarlatos, L.L. Towards reliable computer vision-based tangible user interfaces. *Proceedings of IASTED-HCI 2005* (Nov. 2005), 155-160.

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