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Chatzistavros, Evaggelos

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Comparative Performance Evaluation of Image Descriptors Over IEEE 802.11b Noisy Wireless Networks

Evaggelos Chatzistavros Savvas A. Chatzichristofis Georgios Stamatellos Kostantinos Zagoris
Department of Electrical & Computer Engineering,
Democritus University of Thrace, Xanthi, Greece
{ec3526,schatzic,gstamate,kzagoris}@ee.duth.gr

***Abstract*—In this paper we evaluate the image retrieval procedure over an IEEE 802.11b Ad Hoc network, operating in 2.4GHz, using IEEE Distributed Coordination Function CSMA/CA as the multiple access scheme. IEEE 802.11 is a widely used network standard, implemented and supported by a variety of devices, such as desktops, laptops, notebooks, mobile phones etc., capable of providing a variety of different services, such as file transfer, internet access et.al. Therefore, we consider IEEE 802.11b being a suitable technology to investigate the case of conducting image retrieval over a wireless noisy channel. The model we use to simulate the noisy environment is based on the scenario in which the wireless network is located in an outdoor noisy environment, or in an indoor environment of partial LOS - Line-of-sight power. We used a large number of descriptors reported in literature in order to evaluate which one has the best performance in terms of Mean Average Precision - MAP values under those circumstances. Experimental results on known benchmarking database show that the majority of the descriptors appear to have decreased performance when transferred and used in such noisy environments.**

***Keywords*-Ad Hoc; Image Retrieval; Image Descriptors; BER; WLAN**

I. Introduction

Nowadays, there is a serious change in the way information retrieval is conducted. Recent commercial applications, such as Google Goggles[1] allow a user to conduct a search based on an image stored or taken by its mobile device. There may be a limited number of applications supporting this type of information retrieval, such as retrieval of famous painting and logos, however such systems will be able to retrieve any kind of information in the near future. Search process through those systems requires information exchange between the end-user and the server, about the query image.

Two major problems in Wireless Networks are signal interference and signal fading. Signal interference is caused by the presence of different signal sources transmitting at the same frequency, 2.4 and 5GHz in the case of IEEE 802.11 networks. Signal fading is caused by multi-path effect, meaning that a transmitted signal may have multiple duplicates traversing through different paths to reach a receiver, therefore the received signal should be the sum of all these copies of the multi-path signals.

Moreover, signal quality degradation due to noise and distance has an effect on Bit Error Rate - BER. As the transmitted signal gets weaker and becomes less tolerant to noise, there is an increase in the number of errors at the receiver, meaning increased BER. There has been a significant amount of work on the behavior of a wireless noisy channel, the effect of fading in wireless networks, the relationship between Signal to Noise Ratio - SNR and BER and in most cases researchers have proposed methods to improve a network's performance in terms of signal processing. An error detection and/or correction method such as Automatic Repeat Request (ARQ)[1] could face this problem. Basic principles on how to calculate BER are shown in section II.

In this paper we examine the effects of signal fading and interference. Our main contribution is that we introduce errors in data transmissions taking place in an IEEE 802.11b Ad Hoc Wireless Local Network. Our scenario involves the transmission of image descriptors (low level features) between two wireless nodes, placed at each other's tramsmission range limits, using UDP (User Datagram Protocol) as the transport protocol[2] . Transmission takes place in a noisy environment, thus bit errors are introduced to the receiver image descriptor files according to noise levels of the simulated environment. Our goal is to evaluate which of the image descriptors is more tolerant to noise, in which case will be appropriate to be used for image retrieval over a noisy wireless environment. In addition, we consider another setup whereby, the query image is transferred through the wireless network. Our goal in this setup is to test the descriptors' effectiveness when query images are corrupted by errors during their transmission. We consider that UDP is appropriate for both setups, since it offers reduced overhead and is faster than TCP, which is vital in the case of a real time application, such as location recognition using a picture taken from a mobile device connected to an IEEE 802.11b network. Moreover it is appropriate for transferring small size packets and it does not support error correction. Since

[1] http://www.google.com/mobile/goggles/

[2] http://www.faqs.org/rfcs/rfc768.html

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