Department of Electrical and Computer Systems Engineering

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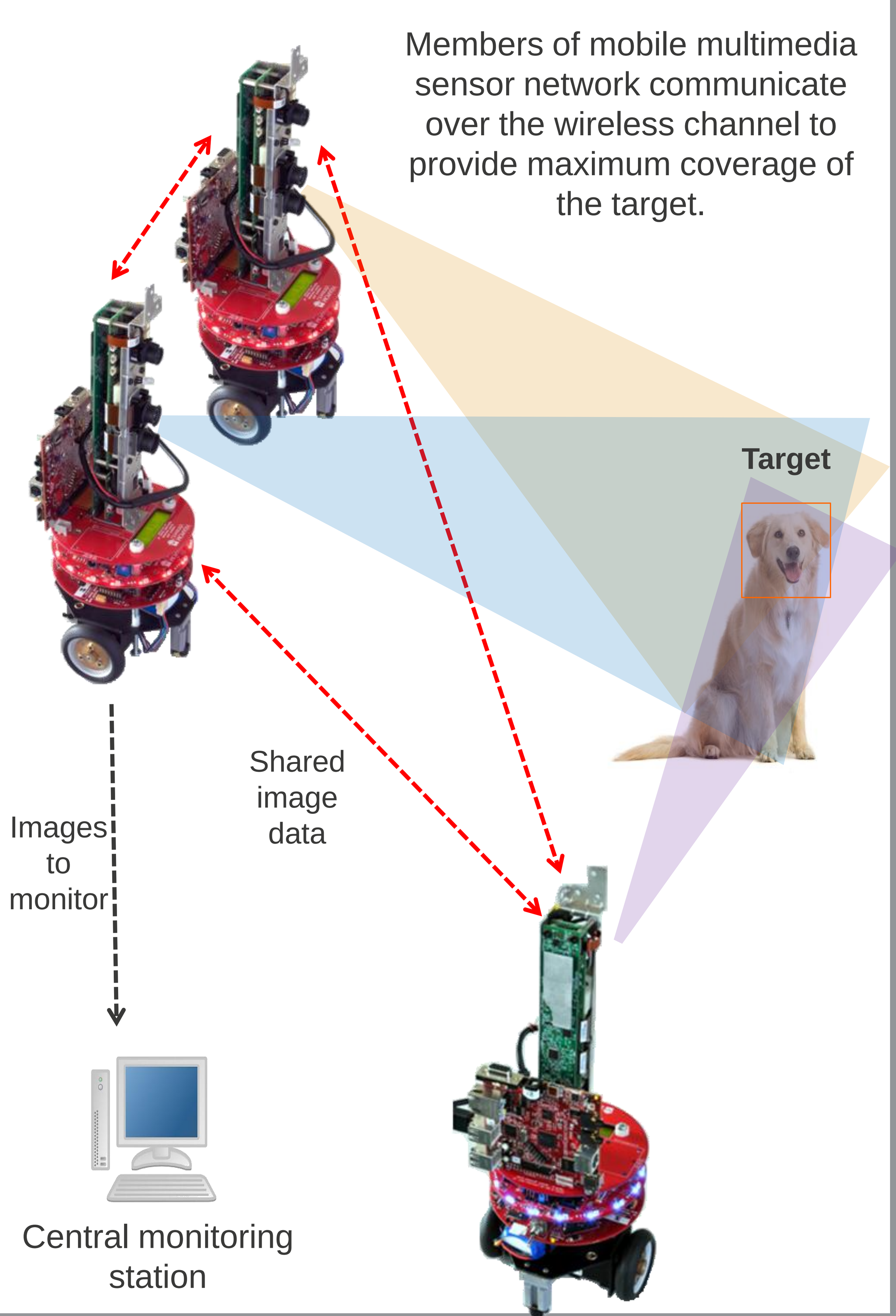
Empirical analysis of 802.11n channel capacity for distributed vision applications in mobile robot networks

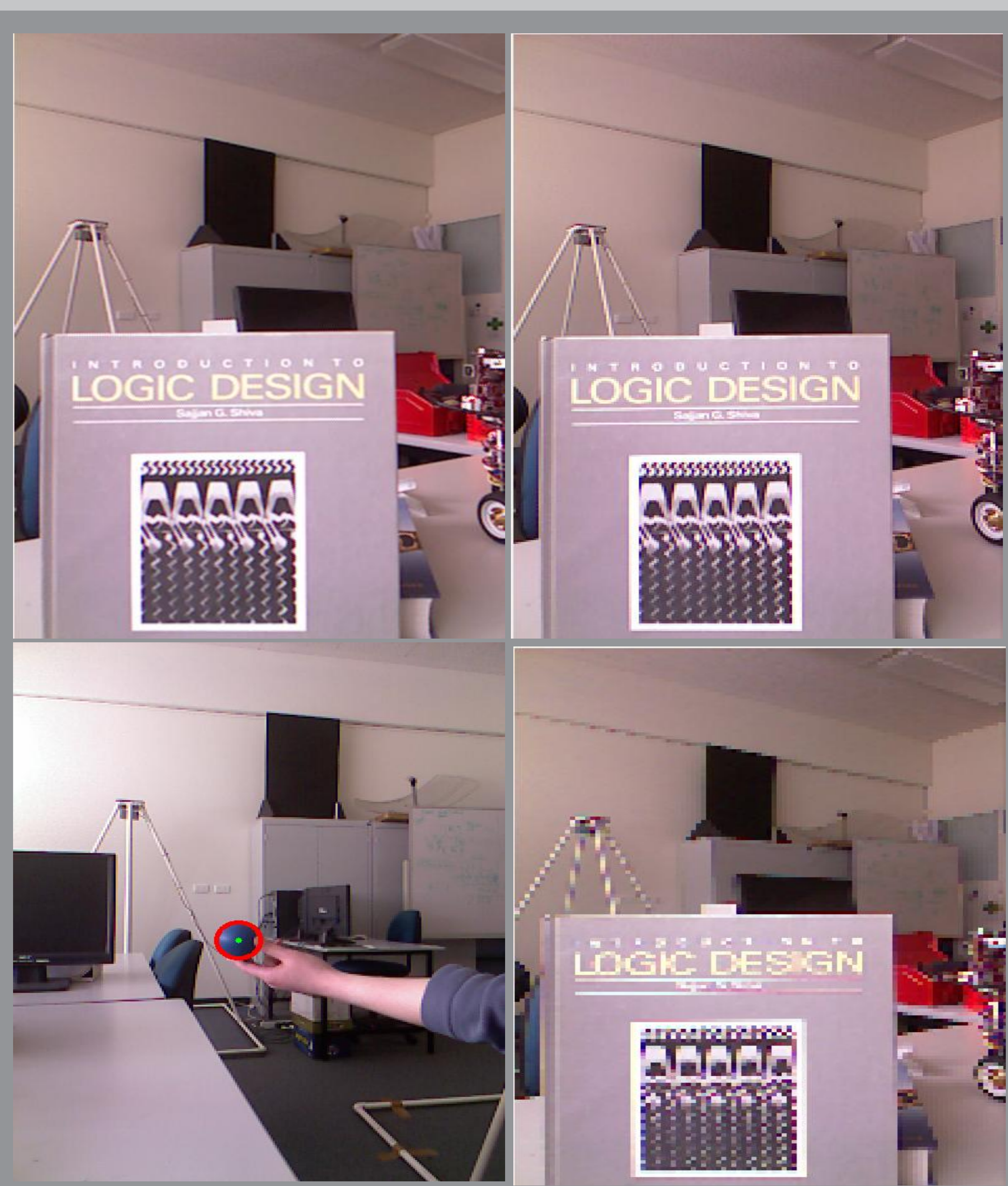
Introduction

This project uses Microsoft Kinect equipped eBugs, 'eyeBugs', to evaluate the performance of 802.11 WiFi for future use in distributed vision applications. This project was undertaken as theoretical analysis of links cannot fully account for the inherent instability of the wireless medium, and neglect the effects of devices on other wireless protocols operating in the vicinity.

To test the link, the eyeBugs stream video data retrieved from the Kinect using an 802.11n link to a remote base station where the images are used in a basic target tracking algorithm. The 802.11 link is tested in both infrastructure and ad-hoc modes of operation.

A typical scenario for future use





Clockwise from top left: uncompressed image, x4 compressed image, x16 compressed image, image with a tracked target

The eyeBug

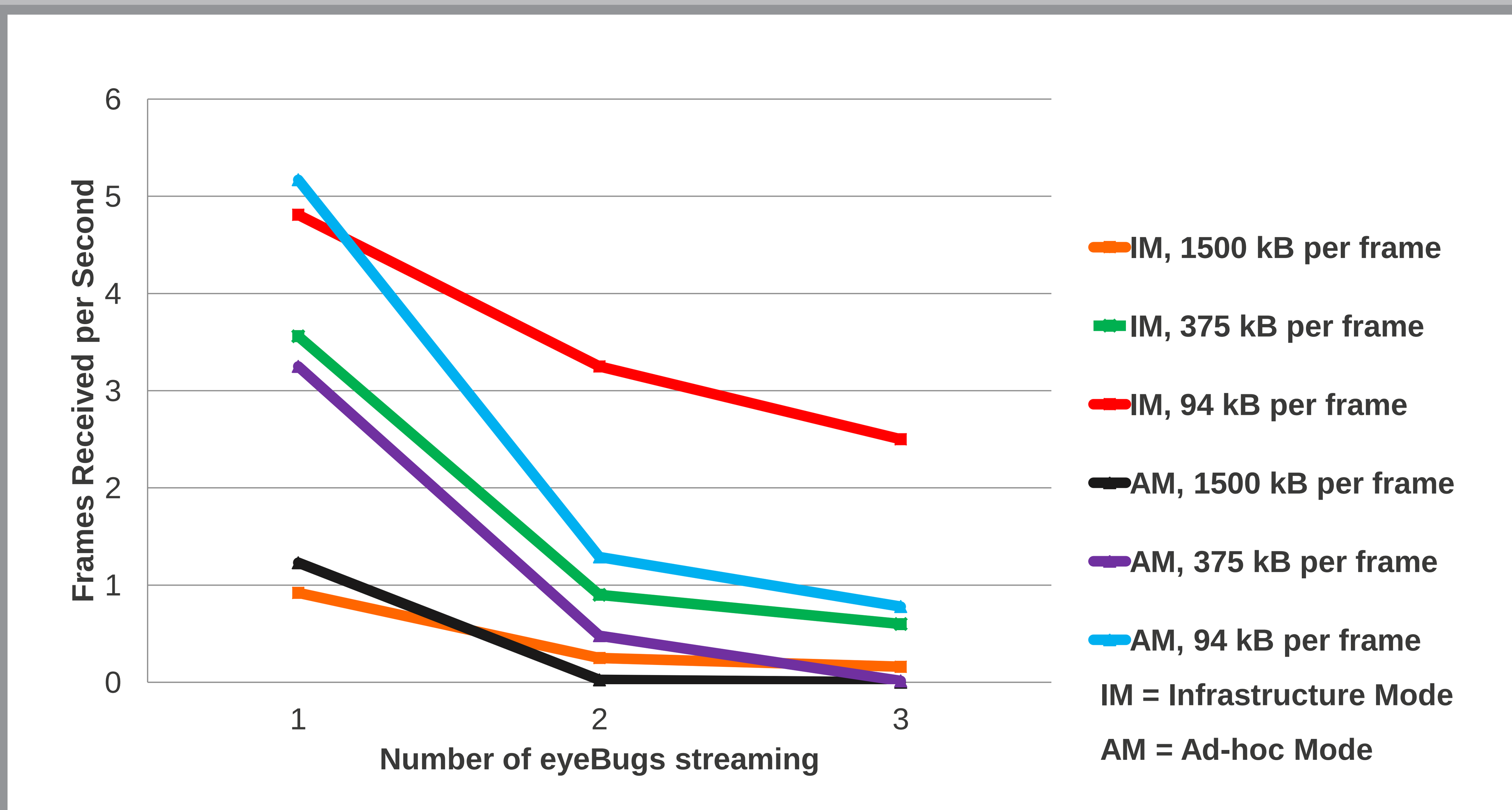
The eyeBug is an extension of the eBug, and can be controlled either via XBee packets or by its onboard Beagle-Board microcontroller. The Beagle-Board runs the Ubuntu 11.10 operating system, and is responsible for testing the link via extracting Kinect images and sending them to a remote base station over the 802.11 link.

How it works

The Kinect sensor data is retrieved from the Kinect, compressed for sending and then transmitted from the eyeBug to a remote computer over the WiFi link. Compression is achieved very simply by breaking the image up into N x N blocks, and sending only the top left pixel of that block. x1 compression uses a 1 x 1 block, x4 compression a 2 x 2 block etc.

Results and Performance

Ad-hoc mode usually has a slight advantage when using a single transmission source, but quickly falls off when additional nodes join. This can be attributed to packet collisions dramatically reducing the effective bandwidth of the link. This problem is avoided in the centralised solution due to the CTS/RTS protocol, which reserves the channel thus avoiding packet collisions, but reducing performance under light loads.



Future Work

Work resulting from this project include developing ways to minimise interference between wireless devices and better media access control to make the most efficient use of available bandwidth. Looking even further ahead would be the creation of a method for a truly distributed computer vision control algorithm.

Acknowledgements:

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