Augmented Reality Library for the Web (tracking.js)

by

Eduardo A. Lundgren Melo

Submitted to the Center for Informatics
in partial fulfillment of the requirements for the degree of

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Abstract

In this thesis, I designed and implemented an Augmented Reality (AR) framework aiming to provide a common infrastructure to develop applications and to accelerate the use of those techniques on the web in commercial products. It runs on native web browsers without requiring third-party plugins installation.This involves the use of several modern browser specifications as well as implementation of different computer vision algorithms and techniques into the browser environment. These algorithms can be used to detect and recognize faces, identify objects, track moving objects, etc. The source language of the framework is JavaScript that is the language interpreted by all modern browsers. The majority of interpreted languages have limited computational power when compared to compiled languages, such as C. The computational complexity involved in AR requires highly optimized implementations. Some optimizations are discussed and implemented on this work in order to achieve good results when compared with similar implementations in compiled languages. A series of evaluation tests were made, to determine how effective these techniques were on the web.

Thesis Supervisor: Silvio de Barros Melo
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Acknowledgments

This is the acknowledgements section. You should replace this with your own acknowledgements [4] foo [5].

This master thesis has been examined by a Committee as follows:

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List of Acronyms

AJAX	Asynchronous JavaScript and XML
BAST	Bug Report Analysis and Search Tool
BTT	Bug Report Tracker Tool
BRN	Bug Report Network
CCB	Change Control Board

Chapter 1

Introduction

This section introduces this master thesis. It will briefly describe the motivation of the work itself, state the problem that we will focus on solving and shortly discuss the proposed solution. In the end, explain the structure of the next chapters.

Micro-optimization is a technique to reduce the overall operation count of floating point operations. In a standard floating point unit, floating point operations are fairly high level, such as "multiply" and "add"; in a micro floating point unit (μFPU), these have been broken down into their constituent low-level floating point operations on the mantissas and exponents of the floating point numbers.

Chapter two describes the architecture of the μFPU unit, and the motivations for the design decisions made.

Chapter three describes the design of the compiler, as well as how the optimizations discussed in section 1 were implemented.

Chapter four describes the purpose of test code that was compiled, and which statistics were gathered by running it through the simulator. The purpose is to measure what effect the micro-optimizations had, compared to unoptimized code. Possible future expansions to the project are also discussed.

1.1 Motivation

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Augmented Reality, Tracking and Detection, Web, Tracking on the Web

1.2 Problem Definition

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1.3 Objectives

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1.3.1 Augmented Reality Library for the Web

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1.4 Thesis Structure

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Chapter 2

Basic Concepts

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2.1 Web

Using concepts from existing hypertext systems, Tim Berners-Lee, computer scientist and at that time employee of CERN, wrote a proposal in March 1989 for what would eventually become the World Wide Web (WWW) [1].

The World Wide Web is a shared information system operating on top of the Internet. Web browsers retrieve content and display from remote web servers using a stateless and anonymous protocol called HyperText Transfer Protocol (HTTP). Web pages are written using a simple language called HyperText Markup Language (HTML). They may be augmented with other technologies such as Cascading Style Sheets (CSS), which adds additional layout and style information to the page, and JavaScript language, which allows client-side computation. Browsers typically provide other useful features such as bookmarking, history, password management, and

accessibility features to accommodate users with disabilities [3].

In the beginning of the web, plain text and images were the most advanced features available on the browsers. Companies behind web browser development together with the web community, were able to contribute to the World Wide Web Consortium (W3C) specifications [2]. Today's web is a result of the ongoing efforts of an open web community that helps define these technologies and ensure that they're supported in all web browsers. Those contributions transformed the web in a growing universe of interlinked pages and applications, with videos, photos, interactive content, 3D graphics processed by the Graphics Processing Unit (GPU), and other varieties of features without requiring any third-party plugins installation.

There are five major browsers used today: Internet Explorer, Firefox, Safari, Chrome and Opera. Currently, the usage share of Firefox, Safari and Chrome together is nearly 60%. The browser main functionality is to present a web resource, by requesting it from the server and displaying it on the browser window. The resource is usually a HTML document.

* Contextualization * Problems of augmented reality on the web * State of the art * History of web * W3C * Browsers * The browser's high level structure * The browser's main functionality * HTML5 * JavaScript * Language details * Typed arrays * requestAnimationFrame * getUserMedia * Canvas * Video * WebRTC * APIs

[1].

2.1.1 State of the Art

2.1.2 Problems of Augmented Reality on the Web

2.2 Augmented Reality

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2.2.1 State of the Art

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2.3 Tracking and Object Detection

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2.3.1 State of the Art

Chapter 3

Augmented Reality Library for the Web (tracking.js)

3.1 Introduction

Supported modules: color, keypoints, rapid object detection.

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3.2 Color Tracking Algorithm

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3.3 Marker-less Tracking Algorithm (Keypoints)

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BRIEF, FAST, RANSAC.

3.4 Rapid Object Detection and Tracking Algorithm

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Viola-Jones: Features, Integral images, Learning, Detection, Training a cascade of classifiers, Training data optimization for JavaScript.

Chapter 4

Evaluation

4.1 Tools

OpenCV, JSFlartoolkit, Others. Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

4.2 Scenario Description

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4.3 Evaluation Methodology

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4.3.1 Matching Robustness

4.3.2 Oclusion Robustness

4.3.3 FPS

4.4 Results

Graphics, Analysys. Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

Chapter 5

Conclusion

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5.1 Contributions

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5.2 Future Work

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