**Universidade Federal da Bahia**
**Universidade Estadual de Feira de Santana**

**DISSERTAÇÃO DE MESTRADO**

# A multi-view environment for markless augmented reality

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CAIO SACRAMENTO DE BRITTO ALMEIDA

# A MULTI-VIEW ENVIRONMENT FOR MARKLESS AUGMENTED REALITY

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## CAIO SACRAMENTO DE BRITTO ALMEIDA

## A MULTI-VIEW ENVIRONMENT FOR MARKLESS AUGMENTED REALITY

Esta dissertação foi julgada adequada à obtenção do título de Mestre em Ciência da Computação e aprovada em sua forma final pelo Mestrado em Ciência da Computação da UFBA-UEFS.

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# ABSTRACT

Augmented reality is a technology which allows 2D and 3D computer graphics to be aligned or registered with scenes of the real-world in real-time. This projection of virtual images requires a reference in the captured real image, which is often achieved by using one or more markers. But, there are situations where using markers can be unsuitable, like medical applications, for example. In this work, we present a multi-view environment, composed by augmented reality glasses and two Kinect devices, which doesn't use fiducial markers in order to run augmented reality applications. All devices are calibrated according to a common reference system, and then the virtual models are transformed accordingly too. In order to achieve that, two approaches were specified and implemented: one based on one Kinect plus optical flow and accelerometer data from augmented reality glasses, and another one based purely on two Kinect devices. The results regarding quality and performance achieved by these two approaches are presented and discussed, as well as a comparison between them.

**Keywords:** augmented reality, augmented reality glasses, kinect, transformation, optical flow, markerless

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# LISTA DE TABELAS

Capítulo
1

*In this chapter I present the motivation, objectives and overview of this work.*

# INTRODUCTION

## 1.1 MOTIVATION

## 1.2 OBJECTIVES

Here we show the diagram with the overview, for example.

## 1.3 THESIS OVERVIEW

Capítulo

# 2

*In this chapter I present the main concepts behind this work.*

# CONCEPTUAL PRIMER

## 2.1 AUGMENTED REALITY

### 2.1.1 Fiducial markers

### 2.1.2 Markerless

### 2.1.3 Direct or indirect vision

## 2.2 CAMERAS

### 2.2.1 Calibration

### 2.2.2 Parameters

### 2.2.3 Multi-view

## 2.3 SENSOR-BASED REGISTRATION APPROACH

### 2.3.1 Kinect

### 2.3.2 Registration

### 2.3.3 Transformation

## 2.4 VISION-BASED REGISTRATION APPROACH

### 2.4.1 Optical flow

### 2.4.2 Lucas-Kanade algorithm

Capítulo

# 3

*In this chapter I present some related works.*

# RELATED WORK

Cover all the related works, with multiple Kinects, optical flow, markerless augmented reality, medical applications, multi-view environment, reconstruction, etc.

Capítulo

4

*In this chapter I explain in details the steps performed in order to implement the objective of this work.*

# PROCEDURE

## 4.1 ENVIRONMENT

Technologies, machines, SOs, etc.

## 4.2 CALIBRATION

### 4.2.1 Augmented reality glasses calibration

### 4.2.2 Initial calibration between Kinects

### 4.2.3 Initial calibration between Kinect and glasses

## 4.3 COMMUNICATION

Network, sockets, etc.

## 4.4 TRANSFORMATIONS

## 4.5 METHOD 1: GLASSES ACCELEROMETER AND ONE KINECT

Cover Lucas-Kanade algorithm, etc.

## 4.6 METHOD 2: TWO KINECTS

Talk about performance of two Kinfus fighting for a single GPU.

## 4.7 HYBRID APPROACH

When optical flow has just a few feature points, we switch to the second Kinect.

Capítulo

5

*In this chaper I present the results of the procedure explained in the previous chapter.*

# RESULT

## 5.1 LIMITATIONS

Talk about error propagation.

## 5.2 ANALYSIS

Talk about performance and alignment results.

## 5.3 COMPARISON

Compare methods 1 and 2 with regards to performance and quality.

Capítulo

# 6

*In this chapter I discuss the conclusions of this work and list some possibilities of future works.*

# CONCLUSIONS

## 6.1 FUTURE WORK