Tracking People with Multiple Kinects

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ABSTRACT
This paper is my undergraduate thesis, completed in School of Computer Science, University of St Andrews, in 2015. The current work is a people tracking system consisted of multiple Kinects. The project aim is to track people in real world environments and resolve the occlusion problem. The final product contains an interactive software for tracking people and an user study on the developed system. The advantages and limitations of the system are discussed.

Author Keywords
Tracking; Occlusion; Kinect; Calibration; HCI

ACM Classification Keywords
H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

INTRODUCTION

Problem statement

The task of detecting and tracking moving targets in real world environment is non-trivial. There are many sources of tracking errors, such as sensor data noise and outliers, illumination levels, changing backgrounds, and occlusion. Real world environments are stochastic. Occlusion occurs when a tracked target is masked by other objects in existing fields of view. The position and movement of an occluded subject are unknown, hence increasing the difficulty of detection and tracking. Occlusions can be static and daynamic, as well as partial and full. Static occlusions refer to situations where stationary objects obstrct the visibility of the target, and dynamic occlusions occur during the interactions of many targets. Partial and full occlusion cases are when the target is partially and fully blocked from the view, respectively. THe current work attempts to resolve all different types of occlusion.

The problem is illustrated in Figure 1.

Contributions

Replicate current research. Resolve the problem of occlusion using multiple Kinects.

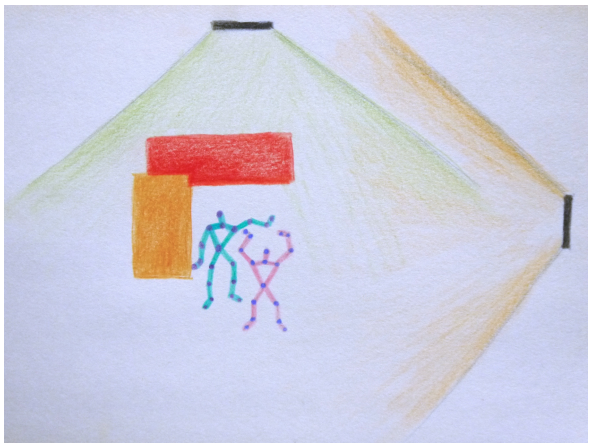

Figure 1: The occlusion problem

1. The first item
2. The second item
3. The third etc

PREVIOUS WORK

Existing people detection and tracking techniques. Tracking people in surveillance video and in realtime. Tracking using mobile and wearable devices. Motion sensors and wireless. Time-of-flight and structured-light cameras.

[Paper: Particle filter to track multiple people for visual surveillance] [Paper: Tracking People in Video Sequences by Clustering Feature Motion Paths] [Paper: Evaluation of realtime people tracking for indoor environments using ubiquitous motion sensors and limited wireless network infrastructure] [Paper: Tracking people under heavy occlusions by layered data association] [Paper: Detection and Tracking of Occluded People]

Tracking people

Coordiante transfomration

[5] [1] [2]

Tracking using depth data

Tracking using color data

[Paper: Tracking people within groups using RGB-D data] [Paper: Detecting and tracking people in real time with

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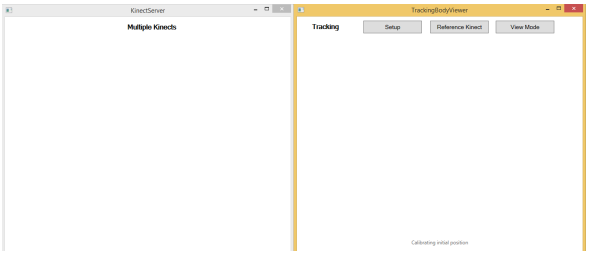

Figure 2: UI

RGB-D camera] [Paper: Applications for a people detection and tracking algorithm using a time-of-flight camera] × [Paper: Real-time Human Motion Tracking using Multiple Depth Cameras] [Paper: Human Detection Using Depth Information by Kinect]

KINECT

The specification and components. Include image Larger field of views. Give examples.

CURRENT APPROACH

Overview

The current system consists of two Kinects and two machines. Each machine is a client running one Kinect, and one machine

Computer Specification

The server machine is running Microsoft Windows 8 on. The other client machine is running

Kinect Body Stream

Clients and Servers

Clients sends the Kinect body stream to the server

Communication Protocol

Serialization

BodyFrame, Body, Joint. The important elements are the tracking state, joint type, amd camera space point.

[4] [3]

Calibration

Discuss the techniques from Wei et al.

Tracking by detection

Skeletons from different Kinects matched based on spatial information. Filling the gaps of skeletons.

Handling occlusion

Handling new skeletons

Advantages

Disadvantages

TESTING

Interactive application. View the average and individual skeletons from different Kinect fields of views.

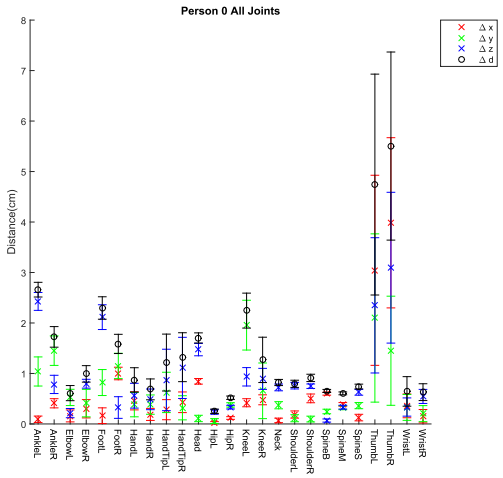

Figure 3: One person all joints

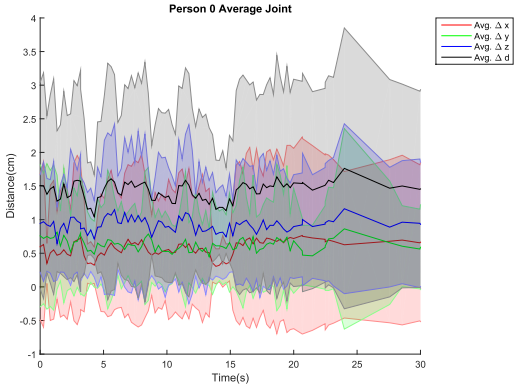

Figure 4: One person average

Occlusion

Show persistent tracking in occluded environments. Demonstrate the system works with complex human interactions.

EVALUATION

Discuss results. Compre them with Wei et al.

User study

Occlusion

User study with multiple people and obstacles.

APPLICATION

SECTION

FUTURE WORK

User studies

Application

SH PROJECT REFLECTION

SECTION

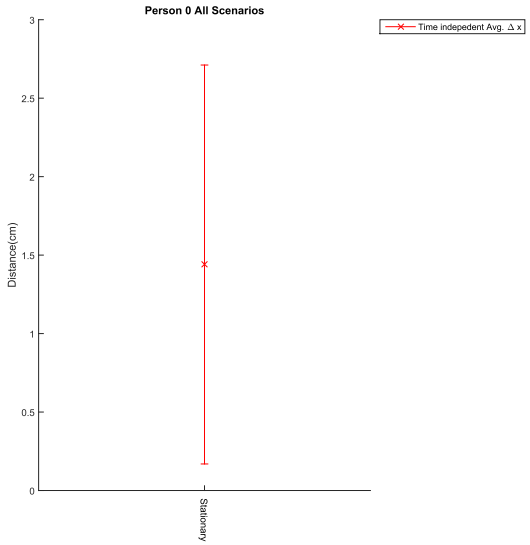

Figure 5: All scenarios

Requirement Specifications

ACKNOWLEDGMENTS

SECTION

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