Tracking People with Multiple Kinects

Chi-Jui Wu
Computer Science, University of St Andrews
United Kingdom
cjw21@st-andrews.ac.uk

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 difficulity 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

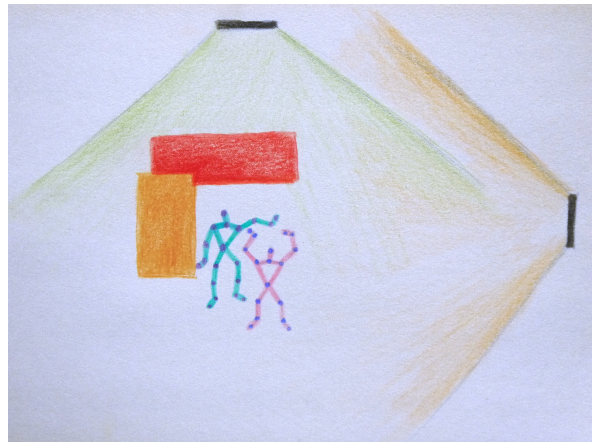

Figure 1: The occlusion problem

Replicate current research, discuss limitations, (in)validate results. Resolve the problem of occlusion using multiple Kinects.

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

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 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.

Features

Multiple Kinects

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 Specification

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

Technique

Discuss the techniques from Wei et al.

Detecting interference

Tracking by detection

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

Detecting occlusion

Detecting new skeletons

Strength

Limitations

Improvements

TESTING

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

Occlusion

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

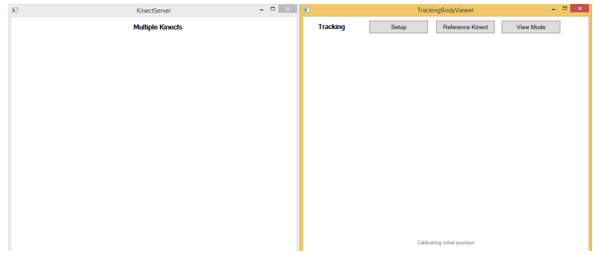

Figure 2: UI

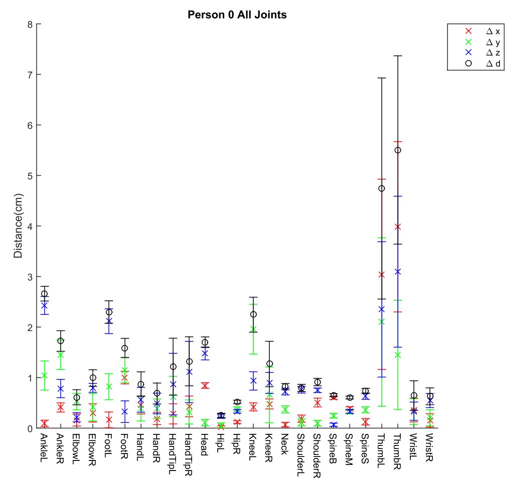

Figure 3: One person all joints

EVALUATION

Discuss results. Compre them with Wei et al.

User study

Study 1

Study 2

Study 3

Study 4

Study 5

Study 6

Occlusion

User study with multiple people and obstacles.

APPLICATION

Features

Tracking UI

Disjoined UI

“Disjoined” or called something else

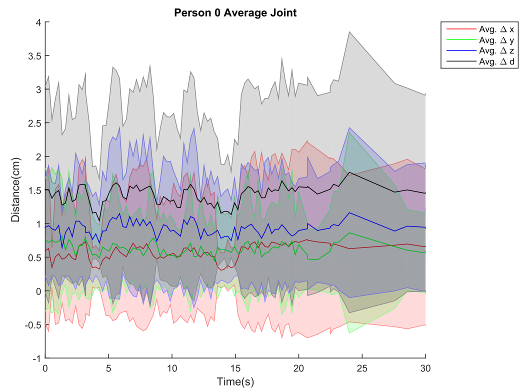

Figure 4: One person average

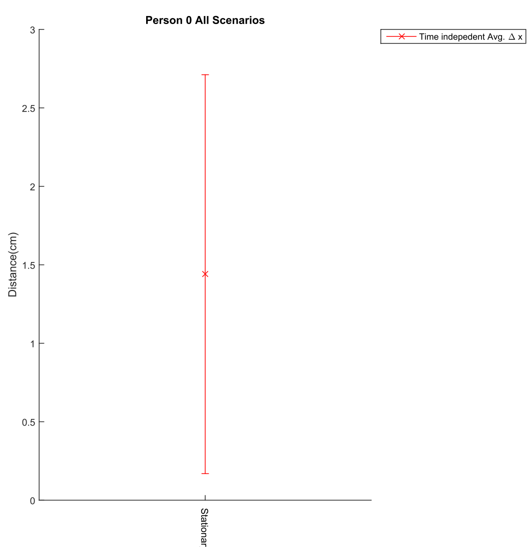

Figure 5: All scenarios

Integration with Heart Rate Monitoring

FUTURE WORK

User studies

Application

SH PROJECT REFLECTION

SECTION

Requirements Specification

ACKNOWLEDGMENTS

SECTION

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