Going out: Robust Tracking for Outdoor Augmented Reality

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Abstract

This demonstration showcases a robust tracking technology for urban outdoor environments. Users will be able to operate a hand-held unit to see and interact with information registered to the surrounding environment. A simple location based game will be part of the demonstration to show the performance of the system. The system uses a novel edge-based tracker which dispenses with the conventional edge model, using instead a coarse textured 3D model. This yields several advantages: scale-based detail culling is automatic, appearance-based edge signatures can be used to improve matching and the models needed are more commonly available. Furthermore, a back store of reference frames with automatic frame selection jump-starts the edge-based tracker after dynamic occlusions or failures.

Keywords: outdoor augmented reality, model based tracking, sensor fusion

1 Storyboard

This demonstration presents the system described in the paper Going Out: Robust, Model-based Tracking for Outdoor Augmented Reality accepted as a full paper for ISMAR’06. It showcases a robust, hybrid tracking system for outdoor augmented reality in urban environments. The setup consists of a hand-held unit equipped with a video camera and an inertial sensor. Users will be able to take the setup for a spin in an outdoor area at the conference venue to test the performance of the tracking system (see Fig 1). A small location based game will be part of the demonstration to encourage the user to move through the environment.

The demonstrated system combines an edge-based tracking approach with inertial sensors and a recovery mechanism in case of tracking failure. Instead of a traditional edge model, the systems employs a textured 3D model. The edges to be tracked are then dynamically determined at runtime by performing edge detection on a rendering of the 3D model from the current pose prediction. This provides three significant advantages: The system automatically performs detail culling and only searches for edge features that are likely to be visible at the current scale. The system is able to extract an appearance signature for each edgel that it wishes to localise in the live feed, thus increasing the accuracy of matching.

Outdoor environments also challenge the robustness of a tracking system to occlusions, large variations in lighting and generally bad viewing conditions. To improve the overall robustness of the system, an additional recovery mechanism was implemented. After pose optimisation, a statistical test detects when the edge-based tracking system fails. In the case of failure, the recovery component tries to match the current video frame to a back store of older frames with known camera pose. If the matching succeeds, the new pose estimate is based on the motion between the stored frame and the current video frame.

The location based game itself tries to capture the Alpine tradition of ‘Fensterln’, an activity where lovers deliver notes directly through a sweetheart’s window. The goal of the game is to locate the right window in the environment and reach it via a ladder. First a ladder has to be found and picked up by walking up to it. Then walking to the ground below the window, the ladder is placed against the wall and the note climbs up the ladder and vanishes into the room beyond the window. However, if one fails to find ladder and window in time, one’s love is lost forever.

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A video is available from http://mi.eng.cam.ac.uk/
gr281/outdoortracking.html.

3 Demo requirements

The demonstration requires an outdoor space preferably surrounded by buildings. Ideally something place in front of the conference venue so that people can find it during the demo sessions.

We will bring the following equipment:

- a hand held computer
- kit with camera and inertial sensor, integrated with the hand held.

We will require a total of 1 power outlets to recharge the hand held computer. A table to put up a sign directing visitors to the outdoor location and some leaflets would be nice too.