Positional Tracking With Time-of-Flight Depth Sensor and Webcam

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Introduction

A virtual reality experience is greatly enhanced when users can directly interact with and modify the world they are in. In order to allow users to manipulate virtual objects, some form of positional tracking is required to keep track of both the user's position as well as any real-world objects that may have influence on the virtual environment.

Related Work

Previous work has attempted to solve positional tracking using inertial [1], magnetic [2], **optical**, or even wi-fi [3] based methods.

Optical tracking can be implemented in a variety of ways, marker-based or markerless, using **color** [4] or **depth**.

Depth cameras use various technologies, from structured light to **time-of-flight** [5].

Approach

We use a combination of RGB webcam and time-of-flight depth data to track markers based on color and general shape.

Process

Input data

We stream high-resolution (640x480) webcam data and low-resolution (320x240) depth images from the SoftKinetic DepthSense 325.

Masking

Using OpenCV we convert from RGB to HSV space, then threshold the color. This is done once for the marker and once for the headset.

Blob detection

We remove false positives from the binary mask by running a blob detection algorithm on the mask. This locates the largest blob of white pixels within a range, ignoring noise and large background patches.

UV mapping to depth

The streamed depth image differs from the color image in resolution and field of view. We warp the depth image to fit our color data.

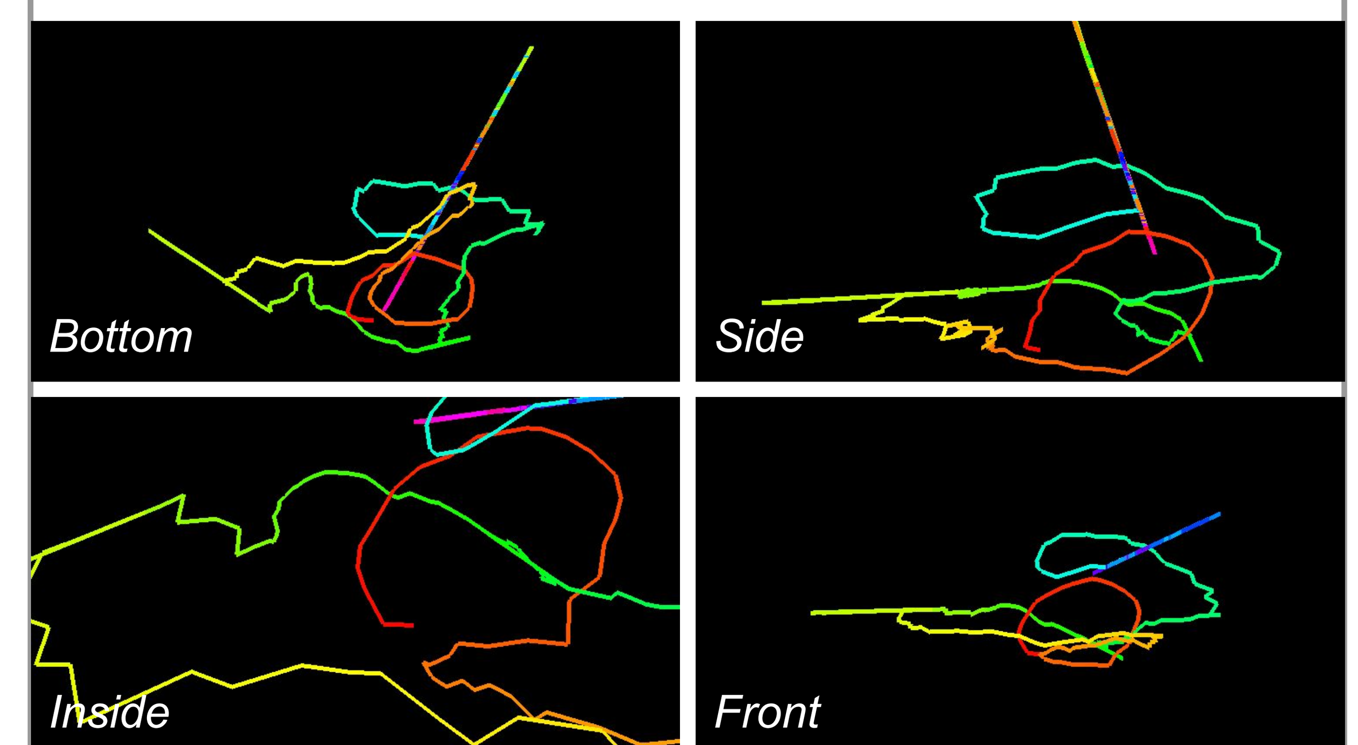
Stabilize depth

We average the depth over a patch of pixels and smooth the HMD position between frames to reduce image jittering.

Coordinate transform

Finally, we use the 3D position of the marker and HMD to transform the marker into view space and render with OpenGL.

Results



HMD tracking allows the user to view a stroke traced out by our tracked marker from various angles.

References

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