CMPE 264 Project Proposal
Impact Alert System

David Goodman
Sharon Rabinovich

Description:

The goal of our project is to design a system that uses a static camera to detect and track the movement of a ball in real-time, and produce an audible alert before the ball hits the camera. The system should predict the trajectory and velocity of the ball. If the ball is expected to hit the camera, then the alert must be sounded before the predicted time-to-contact [1] (TTC) reaches zero.

One possible algorithm for detecting the ball is by computing the optical flow [2, 3,4], since the ball will be the only moving object in the scene. Tracking the ball and predicting its trajectory can be accomplished with a Kalman filter [5] or a Markov model [6], where the prediction horizon will be a function of the ball's estimated velocity and distance from the focal plane. Both the distance and velocity can be estimated from focus of expansion [7, 8, 9].

Platform:

We are exploring various platforms for the system. Currently, both MATLAB and OpenCV on PC and Mac are a possibility. Depending on the performance, we may need to port our code to either a microcontroller or a mobile phone. Our project will also need a webcam, and a distinct-looking ball.

Challenges:

One of the biggest challenges that we expect to face is in achieving a real-time response. That is why we are willing to explore many different types of platforms. Other challenges will be estimating velocity and distance, and predicting the trajectory of the ball.

Demonstration:

We would like to give a live demonstration in front of the class on March 12th. We also plan to show videos of the system in tested scenarios.

Contingency:

If real-time response cannot be achieved in MATLAB, than we plan to use OpenCV. If OpenCV falls short, we will look into our other options: porting the code to a C environment, porting the code to an embedded environment, or porting the code to a mobile phone. If we cannot make the system run in real-time, then we will stick with simulation.

If distance and velocity estimates from field of expansion are too noisy or uncertain, we could measure the ball's perceived diameter in pixels at various distances. A lookup table or spline could then be used to estimate the distance of the ball from the focal plane using its detected diameter in real-time.

References:

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