Name(s)	Project Number
Anurag Singh; Kaushik Tandon	35741

Project Title

Handwashing Hound: Computer Vision System for Monitoring Effective Hand Hygiene

Abstract

Objectives/Goals
The objective is to design a computer vision system to evaluate the handwashing technique of a user for compliance with the handwashing protocol provided by the Centers For Disease Control (CDC). The system should verify the handwashing steps of wetting, applying soap, scrubbing and rinsing.

Even though washing hands is one of the most effective methods of preventing disease, 95% of people do not wash their hands correctly. CDC estimates that worldwide one million child deaths per year could be prevented through proper handwashing. It has published a standard protocol on how to wash the hands. Ensuring compliance with this protocol is crucial to the healthcare and food industries to prevent the spread of germs and is important for the general public to prevent the spread of disease.

Methods/Materials
Our system uses a depth camera pointed at the sink and faucet used for washing hands. This camera provides a RGB color image and an IR based depth image, making it easy to separate the hands from the background. We also used a water powered faucet nozzle with LED light to detect water, which is not easily detected by the depth camera. A laptop is used to analyze the vision data.

The handwashing steps are evaluated by a combination of four Java based detectors: a water detector, a hand detector, a detector for hands in the zone below the faucet, and a soapy hand detector. Our system continuously monitors the state of the above detectors. By observing state transitions, our system infers if the user is wetting their hands, scrubbing hands with soap, or rinsing their hands. Our algorithm for detecting soapy hands can detect soap bubble on the hands of multiple users despite variation in skin color and lighting conditions.

Results
For each detector we measured true and false positive rates and the overall accuracy with more than 3000 samples. Low false positives were observed in all cases. The first three detectors were all more than 90% accurate while the soap detector was 82% accurate, on a per frame basis. The accuracy is excellent as the system can process ten frames per second, minimizing the impact of the errors.

Conclusions/Discussion
Handwashing Hound is a successful computer vision system prototype that provides real time feedback to the user on their handwashing technique. It successfully recognizes and ensures compliance with all four stages of the CDC handwashing protocol.

Summary Statement

The goal of this project is to design a computer vision system to evaluate if the user is washing their hands according to the handwashing protocol identified by the Centers for Disease Control (CDC).

Help Received