An Indoor Positioning System Facilitated by Computer Vision

RUTGERS
WINLAB | Wireless Information Network Laboratory

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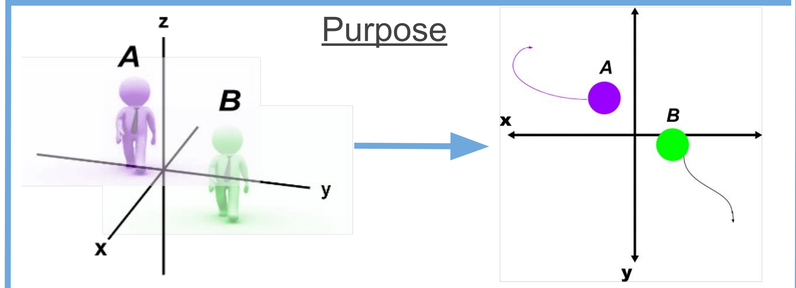
Introduction

- Global Positioning System (GPS) was developed by the US almost 40 years ago
  - It works excellently for positioning outdoors, but becomes quite imprecise indoors, especially in relation to the area of interest
- There have been attempts to solve indoor positioning by creating maps of WiFi interferences in buildings, and publishing this data, allowing positioning devices to monitor the radio interference around them and match their findings to a location
- Our project aims to accomplish indoor positioning with the use of cameras and computer vision
  - This will be more accurate and more scalable
- Applications: Indoor directions, Pedestrian traffic monitoring, Human- robot interaction

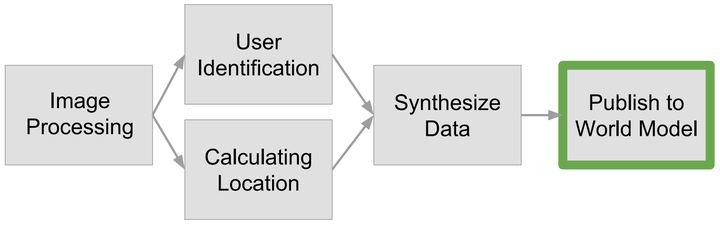
Overview

Purpose



*How can we identify and position people in a 3D environment with **only cameras**?*

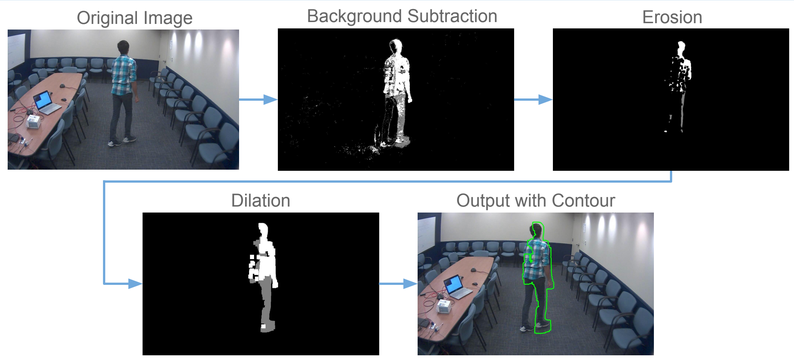
High Level Design



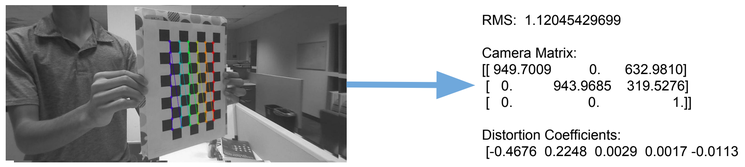
Software and Hardware

- OpenCV (for computer vision libraries)
- Python, C++ (programming medium)
- MATLAB (data filtering and representation)
- AXIS M1054 Network Cameras (stereoscopic camera setup)

Image Processing



Camera Intrinsics



RMS: 1.12045429699

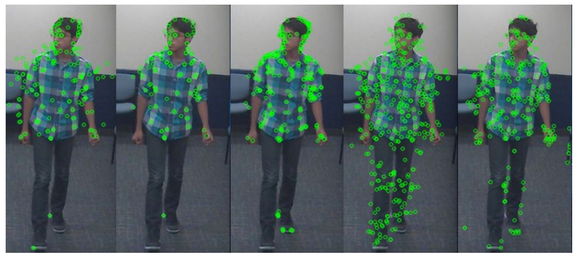
Camera Matrix:
[[949.7009 0. 632.9810]
[0. 943.9685 319.5276]
[0. 0. 1.]]

Distortion Coefficients:
[-0.4676 0.2248 0.0029 0.0017 -0.0113]

- Camera calibration to reduce radial distortion

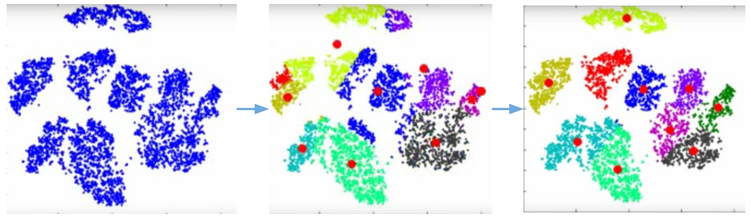
User Identification

Feature Detection



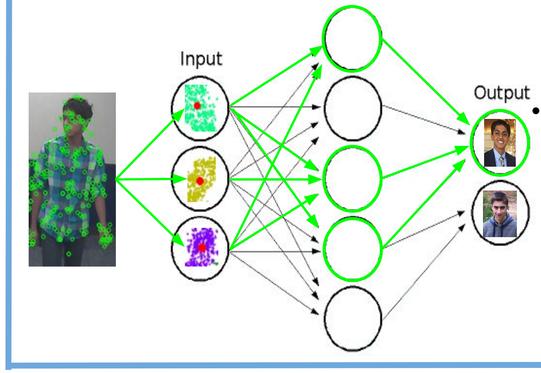
- Detect image characteristics, like intensity edges, allowing the image to be quantized and described

K- Nearest Neighbour



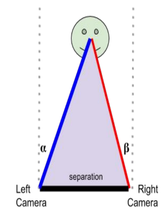
- Take random data and cluster it into a set number of groups

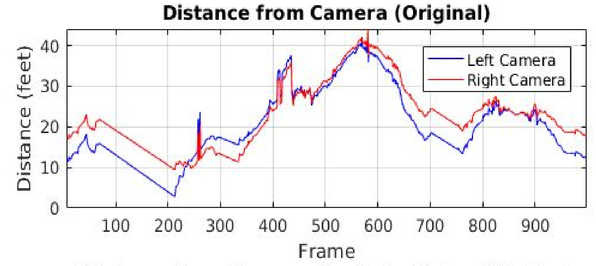
Neural Network



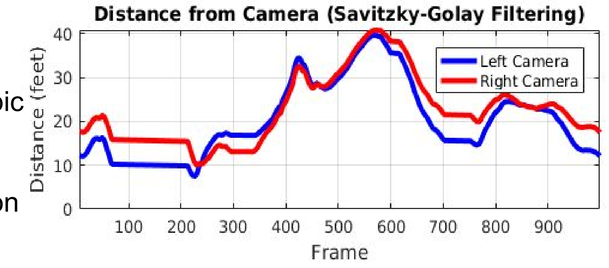
- Map grouped input feature data to users known in a database

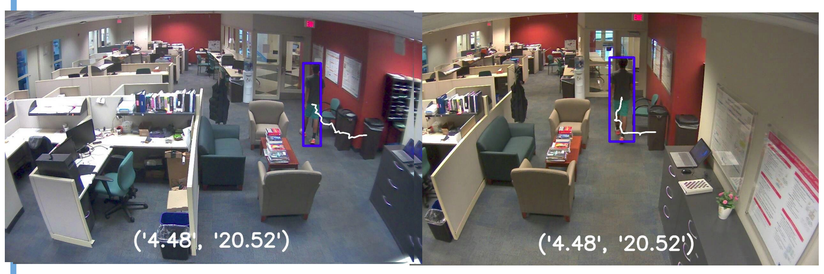
Calculating Location



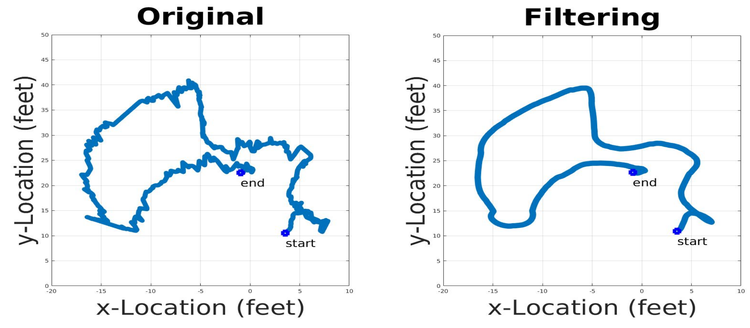


- Angle deviations between stereoscopic cameras allow for triangulation





Position Over Time



References

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- Rosebrook, Adrian. "PyImageSearch - Be Awesome at Learning OpenCV, Python, and Computer Vision." *PyImageSearch*. N.p., n.d. Web. 13 Aug. 2016.
- Matheus, Abner. "Is It a Cat or Dog? A Neural Network Application in OpenCV." Web log post. Tango With Code. N.p., 31 Jan. 2016. Web. July-Aug. 2016.

For more information: http://phalpha1729.wixsite.com/cvips

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