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TRUST

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TEAM FOR RESEARCH IN UBIQUITOUS SECURE TECHNOLOGY

Camera Networks and Computer Vision for Healthcare Applications

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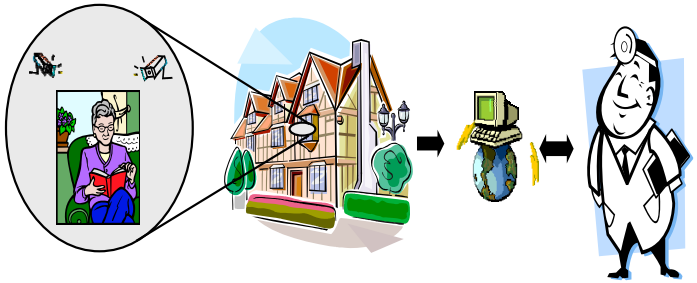
Abstract

Camera networks play an important role in many tasks from surveillance to virtual environments. In this project we look at how camera networks can be used in the healthcare industry for remote patient monitoring. This type of network would be installed in the home and have the ability to alert officials should an emergency arise. A network of this kind would benefit many by enabling the growing number of elderly citizens, to maintain their independent lifestyles as they mature. For this application, it is very important to consider how the camera network is set up. So, this project explored the steps of designing and building a small-scale camera network, which would incorporate background subtraction methods to monitor an individual's movement throughout the room. The initial project description called for the use of multiple web cameras to determine how the internal and external parameters of each affected the background subtraction accuracy. Due to hardware issues we were limited to use of a single web camera to gather valuable test information, using several background subtraction techniques

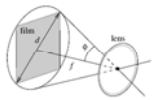
Motivation



- Many senior citizens choosing to retain independent lifestyles at home
- Design and build small-scale camera network, that monitors movement throughout out room
- Camera network alerts proper officials of emergency situation within the home

Methods

- Research high level sensors, such as cameras via technical reports on similar computer vision applications
- Perform camera field of view (FOV) analysis
- Create 2D & 3D FOV MatLab Simulation
- Set-up camera network in test lab area to achieve maximum coverage
- Design program that allows multiple cameras to run and capture images simultaneously
- Capture images from single camera, and perform background subtraction analysis

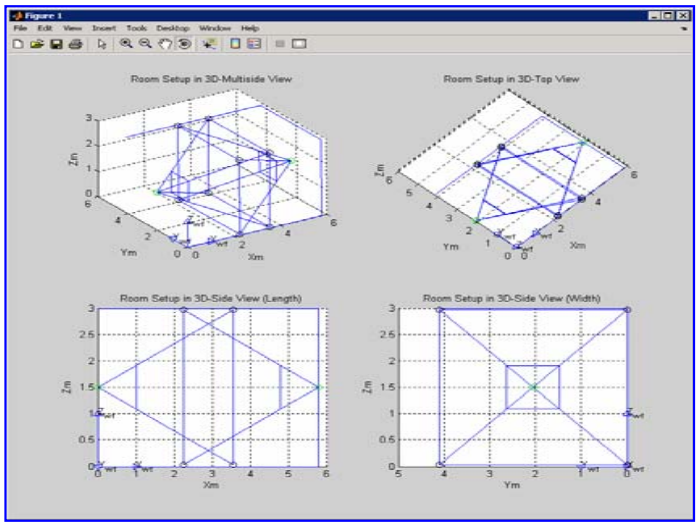


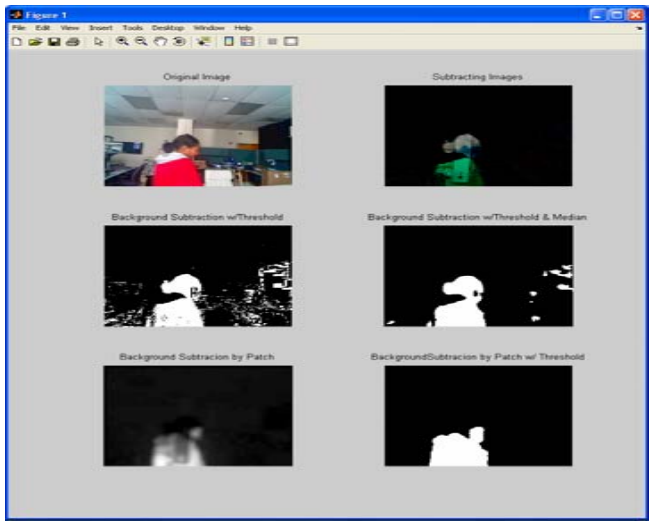
$$FOV = 2\phi$$
$$\phi = \arctan\left(\frac{d}{2f}\right)$$
d = film length (vertical or horizontal)
f = focal length

I. BuddyCam II. Pro 4000 III. Orbit MP

Camera	FOV, Vertical, neglecting f (degrees)	FOV, Horizontal, neglecting f (degrees)	FOV, Vertical, including f (degrees)	FOV, horizontal, including f (degrees)
Buddy Cam	32.203	40.723	31.618	40.008
Orbit MP	48.365	62.703	47.592	61.459
Pro 4000	34.126	47.320	33.535	46.545

Simulation / Background Subtraction Results





- Left: 2D and 3D MatLab Simulations- allows user to create room, insert multiple cameras, and specify location, rotation, and FOV of camera. Used to determine best camera placement so maximum coverage is achieved
- Right: Background Subtraction- Demonstrates the accuracy of pixel, and regional methods. Also shows several clarifying tools used to improve results

Future Work

- Resolve Hardware Issues- Due to bandwidth constraints, and drivers for multiple cameras, had only three cameras running simultaneously. Future system would have at least 6 cameras for FOV set-up
- Calibrate Cameras- calibration using the 2D planar method. Determine object placement within room
- Perform Background Subtraction/ Motion Analysis Tests- using multiple cameras and objects. Test several multiple background subtraction methods, including Mixture of Gaussians

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