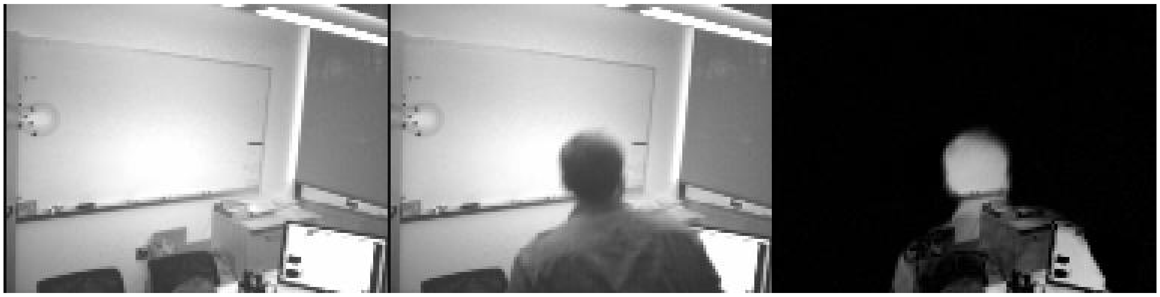
CMSC 143: Introduction to Object-Oriented Programming with Robots

Lab 8: Motion Detection

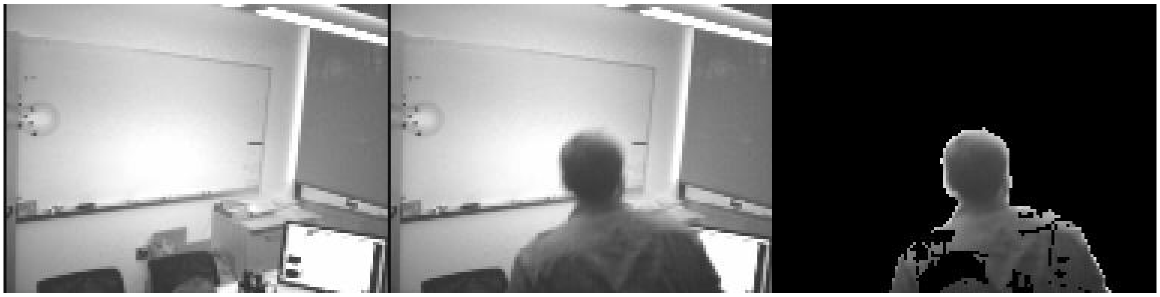
Due April 4, 2011

In this lab we will practice some of the methods we have learned for analyzing images. In particular, we will create a program that acts as a motion detector that could be used for security purposes. We will use a technique called background subtraction to detect changes in a scene. Using gray scale images (`takePicture('gray'); getGray(); setGray()`) simplifies the task slightly.

- `frameDifference(background, newImage)`: Create a function that "subtracts" `background` from `newImage`. Your function should iterate through every pixel in `newImage` and subtract the value of the corresponding pixel in the `background`. This function should return a new image where each pixel is the absolute value of the difference between pixels of the two input images. Include examples images in your report.



- `detectChanges(background, newImage, threshold)`: Create a function that is similar to `frameDifference` but instead of the new image being the difference, we are going to only show the pixels in the newImage that have changed substantially. Specifically, those pixels that have changed by a value of `threshold`. Compare the results of three different threshold values, which value works best for detecting changes?



- Experiment with shrinking your images before detecting changes using the resize function from last lab and the textbook. How does this affect `detectChanges()`? Does it run faster? How does this impact the empirical threshold you found earlier?

- `securityGuard(time)`: This function first takes a 'background' image of what the scene initially looks like (for instance, when you set the motion alarm). Then for `time` seconds, continually takes pictures and passes them along with the background image to `detectChanges()`. If there are substantial changes in the image, save a picture or an animated gif file of the intruder.

Learning Objectives

- Analyze images
- Implement a background subtraction algorithm
- Empirically evaluate an algorithm

Deliverables

Submit via moodle an electronic copy of your program and a PDF answering the questions and including example images:

cmsc143_lab8_LASTNAME_FIRSTNAME.py
cmsc143_lab8_LASTNAME_FIRSTNAME.pdf

EXTRA: ALPHA BLENDING

Along with "subtracting" images, as we did by frame differencing, we can also add them. We can combine the pixels of two images by a weighted average. We weigh one image by a factor called α that ranges from $0-1$ and the other image by $1-\alpha$. This results in a transparency effect and is often called **alpha blending**. Create a new function called `alphaBlend(image1, image2, alpha)` that iterates through the pixels of `image1` and the corresponding pixels from `image2`. Then the red, green, and blue values of the corresponding pixel of the new image is the weighted sum of those from `image1` and `image2`.

$$R_{new} = \alpha \times R_1 + (1-\alpha) \times R_2 \tag{1}$$

$$G_{new} = \alpha \times G_1 + (1-\alpha) \times G_2 \tag{2}$$

$$B_{new} = \alpha \times B_1 + (1-\alpha) \times B_2 \tag{3}$$