Enhanced Human Computer Interaction using hand gesture analysis on GPU

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Abstract
This poster represents a very active research topic in human computer interaction (HCI) as automatic hand gesture recognition using NVIDIA GPU. In this work, neural network-based video gestures are processed and recognized by counting the fingers. Due to real-time requirements, the algorithm needs to be optimized and computationally efficient. We implemented the MATLAB code, which performed slowly when neural network processing started. Implementing them in a parallel programming model such as GPU-CUDA would provide the necessary gain in processing speed. Algorithmic result validation is done using standard video data sets, and the recognition rate is calculated. A performance improvement of 15x speed is achieved, which is faster than Intel quad core processor.

Introduction
The goal of this project is to develop a program implementing gesture recognition. At any time, a user can exhibit his hand doing a specific gesture in front of a video camera linked to a computer.

The program has to collect pictures of this gesture, analyze it, and identify the sign. In order to lighten the project, it has been decided that the identification would consist in counting the number of fingers that are shown by the user in the input picture.

Database And MATLAB Results

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CUDA Approach
1. Camera capture video – process frame by frame image
2. Extract features from the image using various segmentation techniques implemented in MATLAB, CUDA. Output features then written to a text file.
3. Use the matrix obtained in step 2 to train the neural network (on CPU using MATLAB).
4. Once the network is trained, we test it on GPU.
5. GPU implementation -
   a. Load the test image into GPU global memory
   b. Process it as in step 2, output will be a matrix of size (262144 x 1).
   c. Pad the matrix with 0's - output will be a matrix of size (262144 x 16) - Inputs matrix.
   d. This is all done on the GPU. Now pass the neural network weights matrix, to the GPU.
   e. Multiply neuralnetwork_weights matrix by Inputs matrix - which will give a 16 x 16 matrix. Extract the first five values from it. The index of the value which has maximum value + 1 gives us the count.

NN Training Results

NN Training Results

GPU (GeForce GT 525M)

References