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Developing a Mobile App for Region-Importance (ROI) Image Compression

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2015 RCEU Proposal

Title: Developing a Mobile App for Region-of-Importance (ROI) Image Compression

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Project Summary

Mobile devices, social media, RFIDs-enabled ecommerce, the Cloud and Web 2.0 applications are generating and transferring huge amount of visual data. Traditional techniques and tools have difficulty in compressing and reducing these large and complex datasets.

However, not all the information in visual data is created equal. Some regions in an image might turn out to be more important than other regions for a certain application. For instance, human identity information like face or gestures plays a very critical role than background information in video surveillance. Shape and size information related to micro-calcification in the breast cancer X-ray image may contribute more than other features to the diagnosis of breast cancer at the very early stage. In this context, Region of Importance (ROI) is defined as a selected subset of samples within a dataset identified as being important for a particular purpose. For an image, ROIs can be interpreted as some regions containing objects of interest. It is possible to detect such ROIs by using ROI detection algorithms. ROI detection allows researchers or engineers to focus on ROIs to solve a particular problem more efficiently without wasting time and effort on other regions of less importance.

Once the ROIs are detected, we can apply non-uniform compression, which refers to the practice of compressing different regions in the image using different compression techniques, rather than compressing the whole image using a single algorithm. It is usually beneficial to apply lossless compression on ROIs while applying lossy compression algorithms (typically at a much higher compression ratio than lossless compression) on other regions such as the background. Thus, the overall compression ratio for the entire image will increase and the crucial visual information would still be maintained at the same time.

ROI-based image compression would find useful applications in smart mobile devices such as smartphones and tablets. Nowadays, many smartphones and tablets are equipped with incredibly high-resolution cameras. It is reported that approximately 300 million photos are uploaded to Facebook every day. An additional 40 million go up on Instagram while Flickr has 4.5 million. It costs a lot of network bandwidths to upload and/or download the photos to those websites. However, available bandwidths are severely limited and expensive. Hence, compression before image transmission becomes a very straightforward and effective solution to the bandwidth problem.

The aim of the project is to develop a mobile App based on a certain mobile operating system, e.g., Android or iOS. This App should allow users to upload images to the web or store an image on a smart mobile device. Also, a user has the freedom to define any ROIs on an image. Users can use either their fingers or stylus to define certain regions of an input image as ROIs and assign different importance levels to each of these ROIs. Then the users will have the option to choose from a set of compression algorithms we have developed recently to compress those

ROIs. In decoding a compressed image, ROIs of high priority will be displayed first and then users can decide if they want to see the rest of image or not. This will significantly speed up image uploading and storage. This mobile App will allow us to test the ROI compression methods on a realistic setting and draw comparisons with the traditional uniform image compression methods. Besides, user feedback collected after publishing the App could help us further increase the compression and computation efficiencies.

Student Duties

First, the student will conduct extensive experiments on image compression using numerous lossless compression techniques (e.g., Golomb Codes, Huffman Codes and Arithmetic Codes) and lossy compression techniques (e.g., JPEG, JPEG 2000, etc.). To this end, the student will adapt our ROI compression algorithm implemented in Matlab to C/C++ code.

Once the student completes the algorithm implementation and test on a regular PC platform, he/she will be expected to download and install Android Studio/Eclipse or OS X to develop a mobile app, which allows users to capture an image using the camera on a mobile device, define ROIs on the image, compress the image, and then upload the compressed image to the web, or store the compressed images locally. We plan to publish the mobile App on Google Play or iTunes for download and evaluations by users around the world. We will improve the App according to the feedback received.

The student will learn both through self-study and from the faculty sponsor fundamentals of image compression techniques, as well as hardware implementations of image processing and compression algorithms that are not covered by a typical undergraduate course. In addition, the student will gain valuable hands-on experience by learning how to use tools such as the Matlab Signal & Image Processing Toolboxes and C/C++ Programming Environment. Particularly, the student will gain hands-on experience in mobile App development along with interface design and algorithm implementations. Eventually, the studentôs work will be expected to contribute directly to future paper publications co-authored by the student and the faculty sponsor, as well as proposal submissions to external funding agencies to advance the research.

Faculty Supervision and Mentoring

A brief timetable for the project is given below:

Week	**1 -- 3**	**4 -- 5**	**6**	**7 -- 9**	**10 -- 11**	**12**
Task	Image Compression Basic	ROI Compression Algorithms	Midterm Evaluation	Basic Mobile App Development	Implementation of ROI Compression in Mobile App	Final Evaluation & Reporting

The faculty sponsor will be available to provide timely guidance and feedbacks to the student. There will be roughly one meeting per week to ensure constant progress being made. There will be two formal reviews conducted, including a mid-term and a final review, in order to evaluate the performance of the studentôs work and make schedule adjustments if necessary.