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作品名稱	基於演化 K 平均分群法硬體加速之即時電子相片檢索系統 Real-time Photo Retrieval based on Evolutionary K-Means Hardware Acceleration
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作品摘要

隨著半導體製程的進步，行動裝置之電子產品已經成為日常生活中不可或缺的一部份。不同的產品也在時代趨勢下逐漸整合成一種具備各種功能的完整系統。未來，單一產品可能包含不同的功能，不但可以存取電話資料，收發網路信件，也可以進行拍照並且儲存大量相片。同時，電子產品記憶單元的發展更是一日千里。快閃記憶體的容量不斷地提昇，但是其價格與生產成本卻不斷下降。可以預見，傳統硬碟極可能被取代為擁有更大容量的快閃記憶體，或其他更先進的記憶元件。由於快閃記憶體方便攜帶而且擁有高穩定性，這些特性十分適合用於行動裝置上。當這些裝置擁有了大量資料儲存空間，儲存電子相片檔案就會成為一項重要的應用。在成千上萬的相片圖檔資料中，如何有效地搜尋和管理，將成為廠商開發產品所面臨的一大考驗。

基於圖像內容的影像檢索系統，近年來成為十分熱門的研究題目，也有很多軟體系統被開發。然而，這些軟體系統多半以網路圖片搜尋為目標，進而提供使用者一個智慧型檢索平台。在此，本組提出一個不同於以往的全新的觀念：將影像檢索的技術，包括特徵截取以及特徵比對，整合於未來的行動裝置電子產品，並且提供使用者一個功能強大的自動化相片檢索系統。

本組所提出之系統將可應用於行動裝置相關之電子產品，並且建立在單晶片系統的設計平台。它有能力自動地分析任何照片或是影像的內容，並且在很短的時間截取出特徵向量，以利系統進行比對及檢索。

針對影像中不同的特徵向量，K 平均分群法可以自動地將其分群，以簡化影像比對的運算。然而，K 平均分群法在高維度以及高群組數目的情況之下，易於計算出區域性極值，同時也須要極大的運算資源。因此，本組提出將 K 平均分群法以演化計算的方式求出比區域性極值更好的解，並且以平行化的硬體架構進行加速。配合本組所提出的影像檢索之演算法，系統可以自動地分析相片的內容，有效地進行特徵的比對，並且進行即時搜尋。

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Abstract

Due to the advances of semiconductor technology, mobile devices have become indispensible in daily life of people. Different electronics products, such as cellular phones, digital cameras, automatic navigation systems, and portable computers, have been gradually integrated to a single system with versatile functionalities. In the near future, a product might consist of different kinds of capabilities, including the arrangement of telephone directories, the correspondence of electronic mails, and the storage of images and photos. People can use this kind of product to take and store pictures, and to search for related images. Since the cost of memory components, such as flash memory, has become lower and lower, the storage of image database on a mobile device has grown larger and larger. Therefore, it becomes an urgent task for technology companies to develop systems which help customers retrieve and analyze a large number of photos on their products.

The purpose of this work is to provide a solution for photo retrieval in mobile devices. Since it might be troublesome for people to manually annotate the photos they take, it is necessary to establish a system which can automatically analyze the content of photos. The technique to retrieve images based on their content is called Content Based Image Retrieval (CBIR), which has been a popular research topic in recent years.

Many of CBIR systems are intended to be used for different kinds of images on the Internet, and the servers with high performance are used to handle the computation in traditional CBIR system. However, the systems used in mobile devices usually have few hardware resources because low power consumption is a critical issue for them. Therefore, a suitable photo retrieval system should obtain an acceptable tradeoff between retrieval performance and real-time requirements.

Based on these observations, a photo retrieval system targeting on the embedded system for mobile devices is proposed. The proposed system is designed to search for photos with similar spatial layout, and it provides a systematic method for users to query photos with their portable devices. The contribution of this work is twofold: the first is an algorithm for photo retrieval based on spatial layout, which automatically search for photos with similar scenes; the other is a robust hardware architecture for K-Means clustering, which can be used for various applications for video content analysis.