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*Abstract*—健康飲食是現代倍受重視的議題，而且全球有超過13%的人口有體重過重的問體，此外對於特定族群如：健身者、心血管疾病或糖尿病患者營養控管幾乎是每天必須面對的課題，然而多數人並不具備充足的營養學知識，且又不願意而外花時間獲取食物的營養資料，所以我們期望藉由影像處理的技術從照片中獲取關於食物的營養資訊，如此人們就可以藉由手機的拍照功能快速的的針對食物的營養成份進行初步評估，而針對這個問題我們的處理可粗略分成三個階段，首先我們必須進行image segmentation，因為我們必須將外在環境或是非關注的食物與我們所要進行評估的食物分隔開來，針對這裡所採用的是基於顏色的分割方式，針對影像的顏色強度進行分析，找出顏色劇烈變化處作為輪廓，再針對輪廓的位置和大小來對於食物進行定位，第二個階段為食物分類，成功分割出食物後，必須要判定食物的類別，而我們所採用SVM作為classifier，我們分別抽取出了食物的顏色、紋路和形狀並以此作為分類的依據，最終還必須估算食物的大小才可以正式評估營養成分，實際上沒有任何方法可能從影像中得到準確的食物體積，因為體積是三維度的資訊，並不包含在影像當中，不過由於此技術為輔助性質，因此只需完成初步估算再由使用者調整即可，我們採用的是先定義一個物體如手指作為比例尺，再由此物體和食物的面積大小的比例估算物體的體積，皆者由資料庫取得食物的營養成分。

Keywords—Segmentation, Feature extraction, Classification, Food recognition, Calorie Measurement

# Introduction

飲食是人們每天生活中所必須的，然而多數人卻沒有任何營養學的相關知識，而且也不願意的繁忙的生活中付出大量的時間紀錄和分析食物的營養成份，[1]便有提及飲食和肥胖間的關係，不重視飲食所付出的代價便是大量上升的肥胖率及各種疾病患者人數的增加，Who近年的統計也顯示有超過十分之一的成年人有嚴重的肥胖問題，而[2]的則顯示了許多糖尿病患者對於自己的飲食缺乏足夠的理解，這些研究都顯示了瞭解所攝取的食物的營養成分並進行控管是極為重要的，若能夠藉由影像處理技術使營養分析的過程簡化並使其更加便利，如此即便不具備營養學背景知識的人也可以很高效率的自主進行營養的控管。

我們以此題目為目標的原因是因為我們本身對於飲食和營養學有興趣，並且也十分注重自己的飲食，但是對於市面上的飲食管理軟體的性能無法滿足，所以期望能自行設計出性能佳的飲食管理輔助程式，而又因為我們有接觸過影像處理和機器學習的技術，所以我們期望能將這些技術用於飲食管理，所以最終我們定下了目前所選的題目作為期末專題，而此專題的主要目的並非絕對準確的全自動分割和預測食物的營養成分，因為影像為非立體的，任何技術都不可能達成完美的分割和預測，我們主要的想法是希望能夠設計一個半自動的輔助方法，並且可以利用少量資源快速運作，便達成一定的準確度，讓使用者能在小型電子裝置如手機上使用，並只花費極少量時間進行錯誤修正和記錄，故而雖然很多強大的類神經網路模型可以達到非常高的食物分類準確度，但我們卻選用傳統影像處理的特徵萃取加上SVM的方式進行分類，主要考量是類神經網路模型需消耗大量運算資源，不適合在攜帶式裝置上離線使用，而且提升的準確度仍有限。

我們的期末專題為進步型，過去已有一些針對食物影像辨識的論文，它們可能簡單應用食物的顏色形狀等分類，但是他們未必有針對現實的各種環境影響考量，如光線變化對顏色的影響，此外當存在多個食物時進行分割也有在我們專題專進行研究，而且我們期望的是盡可能簡化模型，而非依靠參數非常龐大且複雜的類神經網路模型直接處理影像，如此才可以比較方便的在手機等小型電子產品進行離線的應用，所以我們要先藉由許多影像處理的技術萃取特徵，在以簡單的SVM模型進行分類。

我們專題的code中texture extraction、color extraction、shape extraction和模型訓練及測試皆為自己所寫，而Segmentation的部分則為參考各種他人流程後自己改寫，而營養預測也完全為自己所寫，我們幾乎沒使用任何網路現成的code，但有小部分參考了論文上所提供的程式碼，自力完成比例約80%。

# Related WORK

目前在飲食攝取評估方面有許多相關研究，較早期的方法是藉由臨床實驗進行評估，其中24 hours Dietary Recall[1]，此種評估方式主要就是將24小時的飲食攝取以特定格式列出，然而這種方法需要有營養學背景的人士監督和指導才能進行，而此種方法雖然準確度較高，但必須仰賴受評估者的高度配合，對於一般人難以實現，此外也有受評估者回報不確實的問題，因此又衍生出了一些透過攜帶式裝置輔助和記錄的方法如[3]、[4]，然而這些方法即使透過器材輔助，對於未受訓的使用者而言要花大量時間進行記錄，而且操作未必正確，這些都導致了評估出現嚴重誤差，難以將這些方法普及到正常的使用者，因此開始有透過食物影像進行營養評估的方式被研究，在[5]所提到的就是透過手機拍照進行評估，然而此方法並未考慮到食物份量，而且也只單純使用食物影像跟資料庫影像進行比對，要能正確分類食物仍很困難，為了更準確分類食物，而因為影像辨識的技術提升，開始有透過機器學習和影像處理的技術輔助進行食物分類的方法被研究，如[6] 的方法就是透過影像分割和影像特徵萃取的技術從影像中獲得資訊後由SVM的模型進行分類，而其主要是用影像的顏色、形狀和尺寸分類，我們所設計的系統也是藉由影像分割後特徵萃取再由SVM模型進行訓練，但我們所刪除了尺寸的特徵並加上紋理的特徵，因為顏色形狀相似的食物過多，而紋理也常為食物分類的依據如[7]提及將食物紋理萃取並分類的方法，我們的方法是將影像先進行分割，得到我們所關注的各別食物的範圍，再將此範圍的影像進行上述三種特徵的萃取，並且預測此範圍的面積，以此大略估算食物的份量。

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*a**b* 

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1. M. Livingstone, P. Robson and a. J.Wallace, "Issues in dietary intake assessment of children and adolescents," Br.J.Nutr, vol. 92, p. S213– S222, 2004. J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.
2. J. Saadinem, K. Flegal, G. Beckles A. Fagot-Campagna, "Diabetes, impaired fasting glucose, and elevated hba1c in US adolescents," the third National Health and Nutrition Examination Survey," Diabetes Care", vol. 24, 2001, pp. 834–837. K. Elissa, “Title of paper if known,” unpublished.
3. L. E. Burke et al., "Self-monitoring dietary intake: current andfuture practices," Journal of renal nutrition the official journal of the Council on Renal Nutrition of the National Kidney Foundation, vol. 15, no. 3, pp. 281–290, 2005.
4. J. Beasley, "The pros and cons of using pdas for dietary selfmonitoring,"Diet Assoc, vol. 107, no. 5, 739 2007.p. 301, 1982].
5. C Gao, F Kong, and J Tan, "Healthaware: Tackling obesity with

health aware smart phone systems,"IEEE International Conference on Robotics and Biometics, 2009, pp. 1549–1554

1. Gregorio Villalobos , Rana Almaghrabi, Parisa Pouladzadeh, Shervin Shirmohamm, "An image procesing approach for calorie intake ntake measuremen," IEEE International Workshop on Medical Measurement and Applications - MEMEA , 2012, pp. 324-328
2. Bosch, M., Zhu, F., Khanna, N., Boushey, C.J. & Delp, E.J. (2011b) Food texture descriptors based on fractal and local gradient information. Paper presented at Proceedings of the 19th European Signal Processing Conference (Eusipco), Barcelona, 29 August–2 September.

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