[Demo] A Mobile Augmented Reality System for Portion Estimation

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Abstract

Accurate assessment of nutrition information is an important part in the prevention and treatment of a multitude of diseases, but remains a challenging task. We present a novel mobile augmented reality application, which assists users in the nutrition assessment of their meals. The user sketches the 3D form of the food and selects the food type. The corresponding nutrition information is automatically computed.

Index Terms: H.5.1 [Information Interfaces and Presentation]: Multimedia Information Systems—Artificial, augmented, and virtual realities ; I.4.9 [Image Processing and Computer Vision]: Applications ; J.3 [Computer Applications]: Life and medical Sciences—Health

1 Introduction

Optimized food intake is an important factor in the prevention and treatment of a multitude of diseases. The prevention of obesity is a main concern in populations worldwide, as obesity dramatically increases the risk of cardiovascular diseases and diabetes mellitus type 2. Obesity may also be associated with development of certain types of cancer. Obesity is estimated to increase the cost of medical care to 30 % on average [2]. One measure for the prevention of obesity is the education in matters of diet and nutrition.

The assessment of nutritional values of served meals is a complicated task, especially for the non-expert. Conventional approaches require time-consuming weighing or error-prone estimation of the weight and a cumbersome search for best-matching food items in tables to determine the nutritional values. Most people have difficulties with the correct estimation of portion sizes [1]. Thus there is a need for easily applicable support systems for portion estimation.

This demo presents a mobile interactive augmented reality (AR) support system for portion estimation. Mobile interactive AR support systems can play an important role in nutrition assessment and the training of nutrition assessment. Mobile AR applications show the camera image of the real physical world on a mobile device screen and overlay the image of the real world with virtual computer-rendered content. Fiducial markers (e.g. credit cards with special patterns) in the real world image and computer-vision algorithms allow an alignment of the real image and the virtual image, i.e. correctly sized 3D objects can be placed in the real world image. For the use case of nutrition and diet education, food items can be placed in the real world in the correct scale. Furthermore the user can interact in 3D with the virtual food, i.e. see the food from different viewing positions (always with the correct scale). Therefore a more realistic and intuitive assessment of the portion size or 3D shape could be achieved with AR as compared to 2D images of food.

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This demo includes different AR portion estimation user interfaces that are part of an application that assists users to assess the nutritional value of served meals (see Figure 1).

Figure 1: Mobile Augmented Reality Nutrition Assessment.

2 A Mobile Augmented Reality System for Portion Estimation and Nutrition Assessment

The goal is to provide a mobile AR application – $\mathrm{Eat_{AR}}$ – that assists the user in nutrition assessment (see figure 1). The $\mathrm{Eat_{AR}}$ application should provide a simple user interface for portion estimation, i.e. for the approximation of the 3D form of the food on the plate. The user positions the smartphone such that the plate is captured by the camera. The camera image is shown on the screen and the user defines 3D forms (approximating the food on the plate) on the live camera image. The nutritional values of the meal (all the food items on the plate) are computed based on the volume and the nutritional value information for each food type per volume.

Prototypes for mobile AR systems for assisting users in portion estimation and nutrition assessment were developed with the Unity framework[1] (version 4.2.2 for the precision measurement and version 4.3.4f1 for the user study) and Qualcomm's Vuforia[2] platform (version 2.6 for the precision measurement and version 2.8.7 for the user study). In this work we present and evaluate two different input approaches for the definition of 3D forms. A demonstration and evaluation version of the $\mathrm{Eat_{AR}}$ application can be downloaded at: `http://smarthealth.at/eatar-userstudy/`.

2.1 3-point user input

In the first approach a 3D form is defined by three 3D points and a real-valued form modifier (entered by a simple slider and further referred to as convexity factor Φ). The defined 3D object has a circular base. The user positions the first two 3D points which define the diameter of the 3D object on a plane defined by the marker

[1]`http://unity3D.com`
[2]`http://www.qualcomm.com/solutions/augmented-reality`

IEEE International Symposium on Mixed and Augmented Reality 2014
Science and Technology Proceedings
10 - 12 September 2014, Munich, Germany
978-1-4799-6184-9/13/$31.00 ©2014 IEEE

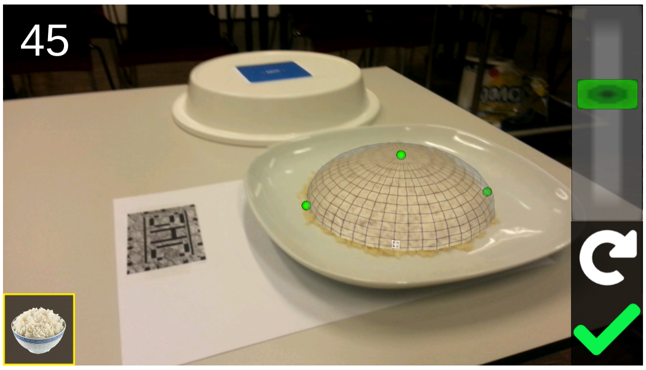

Figure 2: 3-point user input (one minute countdown is shown in the upper left corner)

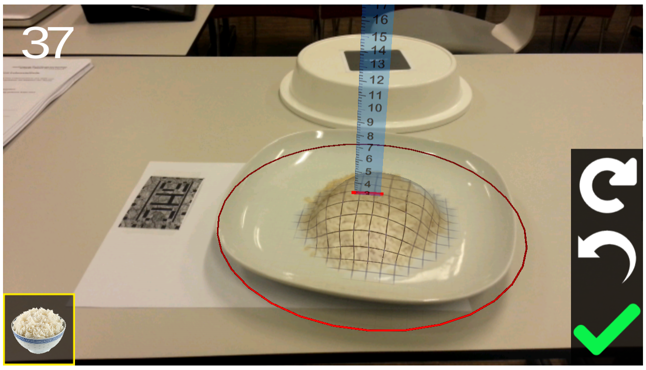

Figure 3: Mesh deformation user input (one minute countdown is shown in the upper left corner)

by a simple touch gesture in the image. The position of the third 3D point defines the height of the 3D object. It is automatically positioned on a line segment starting from the center point of the two previous 3D points and upwards pointing normal vector of the plane. After initial positioning the points can be dragged to precisely adjust their position. In Figure 2 a screenshot of the 3-point user input is shown. The three 3D points are highlighted in green. Additionally the entire 3D object can be moved on the plane by dragging the move symbol at the base of the 3D object. On the right is a slider to adjust the convexity factor Φ. The maximum value of Φ corresponds to a cylinder, a medium value (as shown in Figure 2) to a half sphere and a lower value to a more concave form. In between values correspond to interpolations. Below the slider is a reset button (which restarts the positioning process) and an ok button to finish the portion estimation.

2.2 Mesh deformation user input

The second user input approach works with a simple touch gesture. The red circle in Figure 3 determines the drawable region. The duration of the touch event determines the height and width of the 3D form (the longer the bigger). A ruler is automatically positioned at the highest point of the mesh. Thus the user is provided with a very simple and interactive interface, that allows to “paint” the food on the plate. On the right side there are a reset button (restart with an empty plate), undo button (undo the last mesh deformation), and an ok button to finish the portion estimation.

3 Conclusion and Outlook

In this work we presented our Eat$_{AR}$ application for nutrition assessment. Two different user interfaces for portion estimation have been presented. We see great potential for AR applications in the field of nutrition assessment. Nutrition assessment can be a crucial Future work will focus on the user-evaluation-based comparison of our approach to computer-vision-based volume estimation methods.

Acknowledgements

We thank Gertie J. Oostingh and Karin Schwenoha, Department of Biomedical Sciences – Salzburg University of Applied Sciences for feedback on the usability of the AR application. We thank Raimund Weitgasser, Department of Internal Medicine – Diakonissen hospital Salzburg. Finally we thank the participants of the study. This work was supported by the Austrian research promotion agency (FFG), project number 839076.

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