Augmented reality menu
project proposal

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1 Introduction

We present our project proposal for class "Topical research themes 1: Mobile sensing". A healthy diet should be the goal of every person, however tracking how much nutrition we consume often requires a big time investment. Our wish is to create an application that will make tracking the nutritional intake simple and offer potential solutions to improve our diet even further.

We plan to create an Android application that will allow the user to sense a meal on a plate via a mobile camera, detect different foods on the plate and display food labels in augmented reality. If we have extra time we will implement extensions listed in section 3.

1.1 Related work

Our approach is currently implemented in several apps using an online API. We will differ in the app's simplicity and the image data will be processed locally, thus offering better privacy and offline mode. Automatic food detection is also subject of continuous research. For comprehensive review see work by Zhou et al. [1].

2 Application core

In this section we present the core of our application. The main challenge is creating the food detection model as it requires non trivial use of deep learning concepts as well as computational and time resources.

2.1 Food detection

2.1.1 Architecture

Our plan is to use a convolutional neural network architecture. The state-of-the-art approach is to take an existing neural net model pre-trained on ImageNet that is suitable for mobile devices such as the MobileNet, and perform transfer learning.

The model will perform segmentation and labelling tasks on food images. Different meal constituents will be segmented and assigned the most probable label.

2.1.2 Data

We will use the Food201-Segmented made by Google as part of work by Meyers et al. [2]. This dataset has total of 12000 segmented and labelled images. This dataset therefore imposes a restriction of labelling capabilities of our model.

2.1.3 Technology

We will use the TensorFlow machine learning platform for all deep learning tasks. After fine-tuning the model on a machine with sufficient resources (e.g. a computational cluster) we will deploy the model using TensorFlow Lite.

2.2 AR application

The application will use the neural network to find areas of different foods on the plate and then show what food is present inside an AR animated grid of labels on a smooth surface near the plate.

The first iteration will take the pixels associated with a certain type of food, calculate their centre of mass and put the label there. The next iteration will draw a border around the detected food type and put the labels table on the smooth surface. The user will be able to associate the border with the label via a colour scheme.

The finished application will have to notify the user when it cannot detect a smooth surface and display the labels as in first iteration.

2.2.1 Technology

We will use the Android ARCore library to display labels. The application will use the phone's back camera to capture the video feed used for the AR.

2.3 Work plan

Week 3 is the week from 19. 10. 2020 to 23. 10. 2020.

Week	Jana	Klemen
3	obtain dataset + read [1]	create a basic app design, include ARCore
4	data exploration (visualisation, cleaning)	surface detection in AR
5	create baseline model	display data to the user on a detected surface
6	deploy baseline model to app + integration with AR	
7	mid semester presentation + discussion over feedback	
8	fine-tune model; including:	improving the AR presentation
9	enhance preprocessing	store user's meal history
10	hyperparameter optimisation	(this can be used
11	experiment with heads architectures	for recommendations as per 3)
12	evaluate final model	improve application design
13	deploy final model	working on additonal features, specified in 3
14	demo and presentation preparation	
15	final presentation + report write-up	

3 Possible extensions

If we have time we may implement a system to store user's diet throughout the day and provide recommendations based on the diet. We will use the online food API to recommend what the user can eat to satisfy his daily nutritional requirements.

4 Application evaluation

We will collect feedback from a testing group of users (around 10) and analyse it with regards to application's speed, prediction's quality and overall user-friendliness (ease of use, design). The feedback will include a questionnaire to express user's satisfaction with the above on a scale from 1 to 10.

The quality of the deep learning model will be evaluated on a held out test dataset as is the standard. Accuracy will be used to evaluate the labelling task and intersection over union for the segmentation task.

References

[1] Lei Zhou, Chu Zhang, Fei Liu, Zhengjun Qiu, and Yong He. Application of deep learning in food: A review. *Comprehensive Reviews in Food Science and Food Safety*, 18(6):1793–1811, 2019.

[2] Austin Meyers, Nick Johnston, Vivek Rathod, Anoop Korattikara, Alex Gorban, Nathan Silberman, Sergio Guadarrama, George Papandreou, Jonathan Huang, and Kevin P. Murphy. Im2calories: Towards an automated mobile vision food diary. In *Proceedings of the IEEE International Conference on Computer Vision (ICCV)*, December 2015.