Food Item Image to Recipe and Its Nutritional Information using CNN

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1. Abstract:

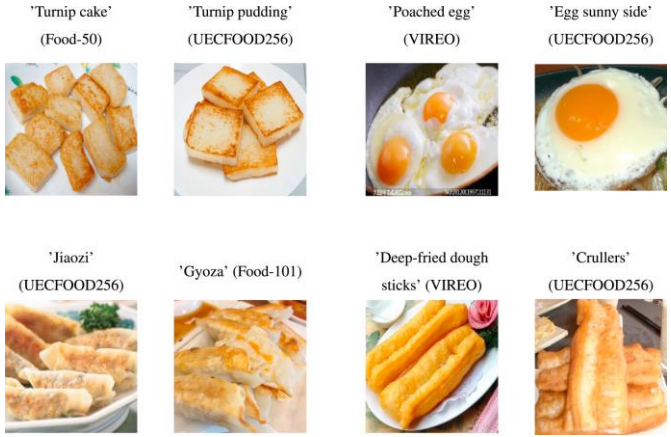
In everyday lives' food plays an important role and dictates one's health in many ways. Proper diet or intake of food with having knowledge on its nutrition improves the health condition. Usually people enjoys the food, and some people appreciates the food by the clicking the photo of the food. Behind every dish there is a complex set of ingredients and instructions for preparation(recipe) and each ingredient has its own Nutritional Information, but unfortunately, we don’t have any access or information about the recipe and its Nutritional Information by simply looking at the photo of the dish.

2. Existing System:

Image classification is very famous problem since many years. If we have good amount of data, there exist very good models for classifying the image and models are exist even for multi classification (Task :Gathering the good amount of Data).

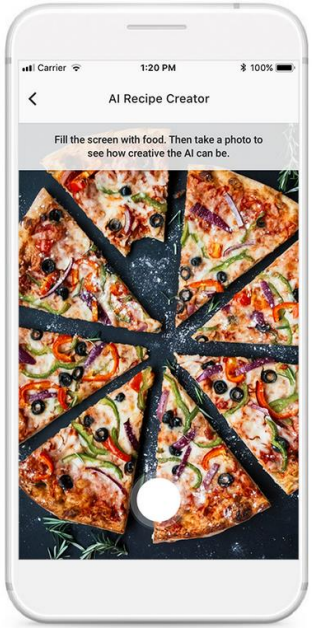
Models/ System for food image classification are existed.

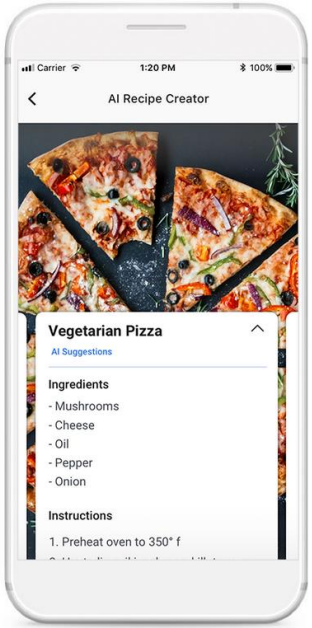
Recently in 2019 some researchers published a conference paper on inverse cooking in IEEE.



3. Proposed System:

Proposed system is to build a model which can that can predict the food item from image and generate the ingredients and recipe along with the nutritional labels, which will be helpful for the food in takers to make best choice to that reaches to their nutrition targets.





4. Literature Survey:

i. *Salvador, A., Drozdzal, M., Giro-i-Nieto, X. and Romero, A., 2019. Inverse cooking: Recipe generation from food images. In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (pp. 10453-10462)*

ii. *Marin, J., Biswas, A., Ofli, F., Hynes, N., Salvador, A., Aytar, Y., Weber, I. and Torralba, A., 2019. Recipe1m+: A dataset for learning cross-modal embeddings for cooking recipes and food images. IEEE transactions on pattern analysis and machine intelligence.*

iii. *H. Lee, H., Shu, K., Achananuparp, P., Prasetyo, P.K., Liu, Y., Lim, E.P. and Varshney, L.R., 2020, April. RecipeGPT: Generative Pre-training Based Cooking Recipe Generation and Evaluation System. In Companion Proceedings of the Web Conference 2020 (pp. 181-184).*

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Paper-1: *Salvador, A., Drozdzal, M., Giro-i-Nieto, X. and Romero, A., 2019. Inverse cooking: Recipe generation from food images. In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (pp. 10453-10462)*

This work has done by the Facebook researchers with AI interns(*https://ai.facebook.com/blog/inverse-cooking*). A new approach to generating recipes directly from food images that produces more compelling recipes than retrieval-based approaches, according to human judgment. Evaluated on the large-scale Recipe1M data set, this approach improves performance with respect to previous baselines for ingredient prediction. With this work, we aim to provide access to the preparation of a meal simply by inputting a food image.

Improvising: Nutritional information can be added to this task. (chosen this paper as base paper.)

Contd..

Paper-2: *Marin, J., Biswas, A., Ofli, F., Hynes, N., Salvador, A., Aytar, Y., Weber, I. and Torralba, A., 2019. Recipe1m+: A dataset for learning cross-modal embeddings for cooking recipes and food images. IEEE transactions on pattern analysis and machine intelligence.*

This paper is published by MIT researchers(*http://pic2recipe.csail.mit.edu*) where they introduce Recipe1M+, a new large-scale, structured corpus of over one million cooking recipes and 13 million food images. As the largest publicly available collection of recipe data, Recipe1M+ affords the ability to train high-capacity models on aligned, multimodal data. Using these data, they train a neural network to learn a joint embedding of recipes and images that yields impressive results on an image-recipe retrieval task.

They have done for cross model(image to recipe and vice versa).

Benefits: This dataset as well as embedding is beneficial to the Project work. They didn’t utilize the Nutritional information that present in their data set.

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Paper-3: *H. Lee, H., Shu, K., Achananuparp, P., Prasetyo, P.K., Liu, Y., Lim, E.P. and Varshney, L.R., 2020, April. RecipeGPT: Generative Pre-training Based Cooking Recipe Generation and Evaluation System. In Companion Proceedings of the Web Conference 2020 (pp. 181-184).*

This paper talks about RecipeGPT, a novel online recipe generation and evaluation system. The system provides two modes of text generations:

(1) instruction generation from given recipe, and ingredients.

(2) ingredient generation from recipe title and cooking instructions.

Cons:

- They didn’t use image for generating recipe.
- Didn’t mentioned any usage of Nutritional information.

Pros:

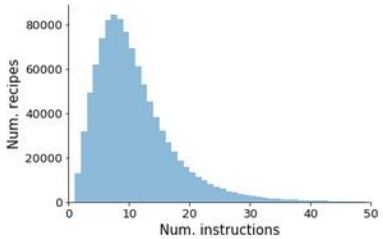
- Process of generation of recipe from ingredients and title of food item helpful.

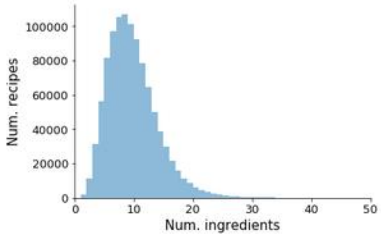
5. About Dataset:

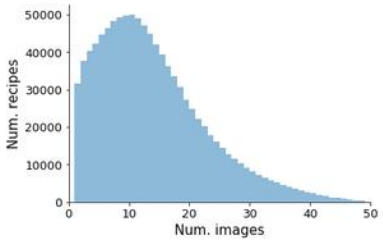
Recipe data:

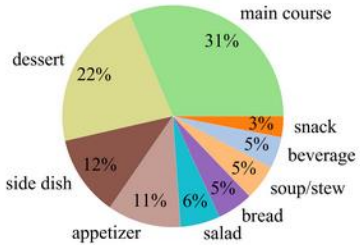
Recipes can be derived from a multitude of sources, such as books, websites, and structured datasets. For the purposes of the publication dataset, I chose to use a collection of recipes gathered by the authors of and used in the making of the Im2Recipe project(Recipe 1M+).

Because the Recipe1M+ dataset contained 1M recipes with 13M associated images, I decided that I would take a subset of the dataset (the Recipe1M dataset) instead of complete dataset due to computational and time constraints.

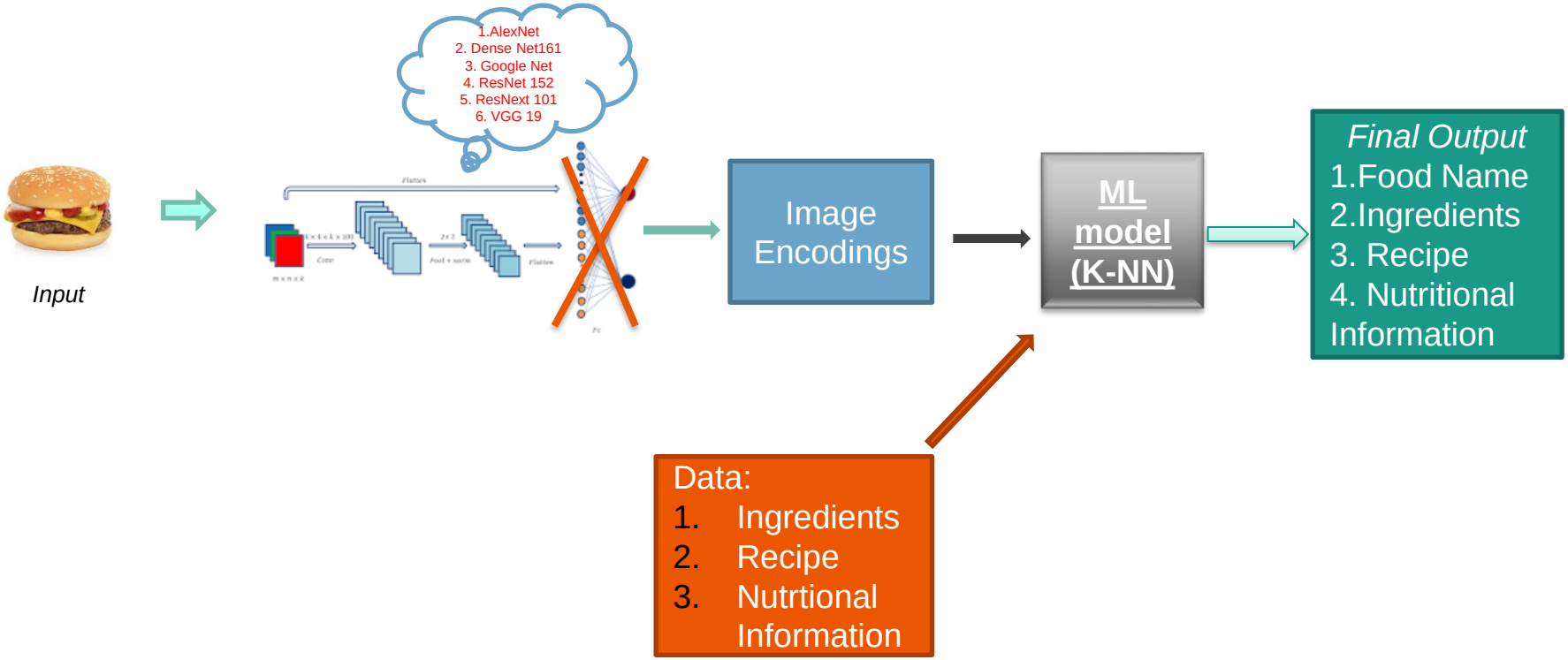








6. Architecture.

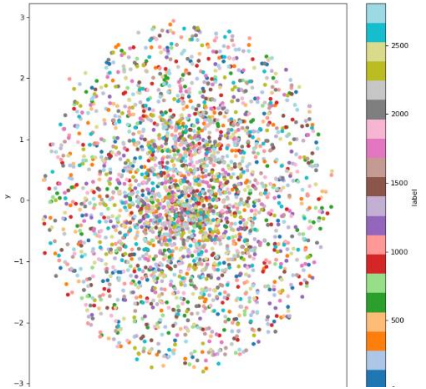


7. Sources and Platforms Used.

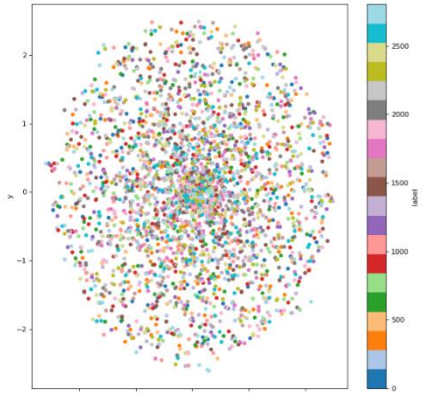
- Data Handling and Processing : AWS Sage maker & S3
- Model Building and Modifying : Local System(16Gb Ram 4Gb Gpu Memory)
- Visualization of Encodings : Google Colab

8. Image Encodings:

MODEL	VECTOR DIMENSION	FILE SIZE
ALEX NET	1024 + 2	4.01 GB
DENSENET 161	1000 + 2	5.46 GB
GOOGLENET	1024 + 2	4.28 GB
RESNET 152	1000 + 2	4.96 GB
RESNEXT 101_32X8D	1000 + 2	4.97 GB
VGG 19	1024 + 2	5.22 GB



t-SNE visualization of 1% DenseNet Encoding



t-SNE visualization of 1% GoogleNet Encoding

8. Results:

- Comparison between Ground truth Image and Retrieved Image:

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Existing System Loses:

Model	ResNet-50	ResNet-101	DenseNet-121
Cosine Loss	0.598	0.588	0.719
Average Euclidean Distance	33.52	33.47	17.97

Proposed System Loses:

MODEL	Distance_ loss_top1	Distance_ loss_top2	Distance_ loss_top3
Alex Net	35.6281	36.8806	37.2691
Dense Net 161	7.96E-07	8.10E-07	8.14E-07
Google Net	7.8552	7.893	7.9125
ResNet 152	0.7635	0.7779	0.7779
ResNext101_32x8d	0.7643	0.778	0.7813
VGG 19	3.1642	3.2286	3.2448

Distance Loss

MODEL	Cosine_ loss_top 1	Cosine_ loss_top 2	Cosine_ loss_top 3
Alex Net	0.7538	0.7388	0.7331
Dense Net 161	1	1	1
Google Net	0.8374	0.8357	0.8349
ResNet 152	0.9988	0.9988	0.9988
ResNext 101_32x 8d	0.9986	0.9986	0.9986
VGG 19	0.9034	0.9004	0.8995

Cosine Similarity Loss

Contd.. Final Output:

input image :

output image :

Recipe Info - 1

Eggnog Cookies

Ingredients:

1 cup Butter, Softened
1 cup Sugar
1/2 teaspoons Nutmeg
1 teaspoon Baking Soda
1 cup Eggnog
4 cups Flour

Instructions:

step 1 : Beat butter and sugar until creamy.
step 2 : Add nutmeg, soda and eggnog to the butter mixture and blend well.
step 3 : Add flour and mix until combined.
step 4 : Drop by teaspoonfuls onto a very lightly greased cookie sheet.
step 5 : Dip the bottom of a glass into sugar and just slightly flatten the cookie.
step 6 : Bake at 375 degrees for 12 minutes or until edges are golden brown.

Nutritions:

fat_status	orange
salt_status	orange
saturates_status	red
sugar_status	red
energy	374.422
fat	16.8515
protein	5.48464
salt	0.302061
saturates	10.2942
sugars	18.7737

9. Future Scope:

After completion of this project, there is a lot of scope in future for this model with the help of Transfer Learning. Having good and enough data for any application that uses this similar process, is enough to implement the respective application with the help of this model.

Applications like:

- Crop classification, process of cultivation of that crop and chemicals required in future or possible disease
- Skin disease classification, cause of the disease and medication or precautions.
- Pet Care.

10. Code

The code for this project is made publicly available in the GitHub. Following link takes to this project code repository.

https://github.com/Balaganesh-Sarvasuddi/PICTURE-TO-RECIPE-AND-ITS-NUTRITIONAL-INFORMATION-USING-CNN-AND-K-NN

THANK YOU!