NEW HORIZON COLLEGE OF ENGINEERING

Autonomous College Permanently Affiliated to VTU, Approved by AICTE & UGC
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Department of Artificial Intelligence & Machine Learning

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Report

for

Mini project-IV (20AIM68A)

On

"Ingredient To Recipe Generator"

By

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CERTIFICATE

Certified that the Mini Project- IV with the subject code 20AIM68A work entitled **"Ingredient To Recipe Generator"** carried out by Mr. Puneet Vernekar USN 1NH20AI082, Mr. Rahul Ravindra USN 1NH20AI084, Mr. Kodidala Vamshivardhan USN 1NH20AI049. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the report. The project report has been approved as it satisfies the academic requirements in respect of Mini Project work.

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Dr. N V Uma Reddy — Head of Department

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Examiner — Signature with date:

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ABSTRACT

Food is a vital part of a person's health and well-being which is crucial for maintaining a good mental and physical state of the body. The common problem that has plagued us is that sometimes it is tough to choose what we need to cook based on the ingredients available. There are a lot of ingredients available which can be used in different combinations to make numerous kinds of food fit for consumption. Our project aims to implement a system where we use deep learning algorithms as RNN, CNN, NLP and LSTM to suggest recipes to users based on the ingredients that has been given by the users. The recipe generation will be done by utilizing a model which comprises a neural network. The main aspect of recipe generation lies in the ingredients that are sourced and will play a key role in generation of recipes.

Our project mainly comprises of two functionalities i.e., ingredient to recipe generator and food images to ingredient and recipe generator. For ingredient to recipe, we have used RNN, NLP and LSTM algorithms, this RNN algorithm is used for the recipe generation as an text generator, LSTM is used for storing the output of the previous layer for a longer time which helps in producing the output for the next layer efficiently. For food image to recipe, we have used CNN to classifying and recognizing the food items and generating the recipe. This will be more useful in cases where people who are inexperienced in cooking can easily select the recipes without having knowledge of it beforehand and will aim to make the process less time consuming. People who are well versed in the field of cooking can also make use of the recipe generator to see the wide variety of recipes that can be prepared.

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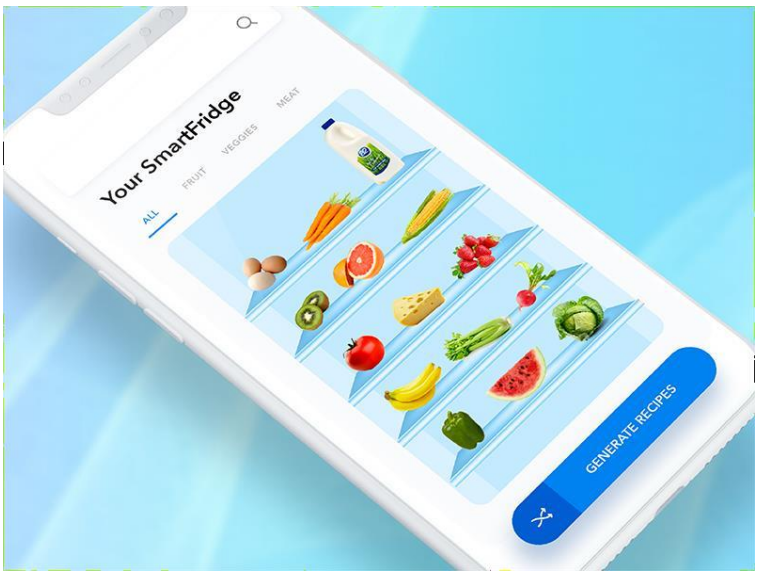
1.1 Introduction

Human beings require proper food to survive and have a healthy life. Food forms a very important component of our daily lives. It is interlinked to every action that we need to perform. Without eating or consumption of food our energy levels will be very low. Due to this it may cause a reduction in the potential level of any activities we need to perform. Since food is such an integral part of our live it becomes increasingly clear that we need to prepare and have food that can increase our energy levels and also make us more productive in the process. Our project is used to generate recipes based on the ingredients received by the user. The recipes will be catered according to the user's choice and it will contain only the ingredients which can be utilized by the user. As we all know preparing food can be a very tedious task and it may be very stressful and time consuming for people to think about what food to cook. Even if we have all the ingredients ready at our disposal to be used it is a little problematic to think as to what food to prepare. In our project we aim to make a system where it becomes easier for the users to quickly come up with a solution as to what food to prepare. This makes the task of cooking or preparing food exponentially easier and will help in mitigating the time spent on it. Instead of spending time pondering about what can be prepared we can use our system to quickly provide solutions to combat that problem. Food wastage is also a cause of concern for many people as once we start to cook the ingredients needed may vary drastically and sometimes it may also lead to excess or wastage of the available ingredients. In this type of scenario our project aims to cut down on the wastage of food as it can project the recipes to the users without any wastage to the ingredients of the users. Since food is extremely important for our livelihood it becomes increasingly important to place more concern on the type of food we consume and not deal with it in a crude manner. Our project aims to make sure that the users can create the food that they desire and is fit for consumption without any qualms and can taste different recipes in an engaging manner. Following this will lead to a healthier diet and will have a crucial effect in changing the dietary patterns and the lifestyle of the people.

1.2 Objectives

The objectives of this project are:

- In this project we are making use of deep learning algorithms to make the ingredient to recipe generation i.e., inputting the ingredients and receiving different recipes based on ingredients.
- The main aim of our project is to generate different combinations of appropriate recipes, so that the user is provided with diverse options to choose of his own. No matter what the ingredients are, still the model attempts to solve this problem by making the combinations with other ingredients.
- The dataset used in this is a recipe dataset which consists of 2 lakh+ data entries so that the model is trained with high accuracy to get an appropriate outputs. This dataset consists of structured cooking recipes which is required to give the proper output.



1.3 Literature Survey

Reference	Methodology	Outcome/Results	Remarks
Identification and prediction of Recipe using deep learning model. Ranjith Reddy, Jogi Krishna. Published in: international journal of creative research thoughts(2022).	CNN model is used which has been trained on recipe details. The system is based on a model called as inverse cooking system which makes use of images.	The model generates cooking recipes based on food images. It uses exhaustive methods to learn the ingredients as both list and set without imposing any order. The dataset used for the model is Recipe 1M dataset. This model achieved an accuracy of 90%.	It gives more recipes than other approaches by utilizing more images. Over a number of epochs the model can differentiate dominant and low level features in images and classifies it.
Cooking recipes generator utilizing a deep learning-based language model. Michal bien, Michal gilski. Published in: reasearch gate(2020)	This project has made use of computational NLP solution that works on machine learning techniques. Another model that has been used is GPT 2 model for generating text of the recipes.	It focuses on the act of creation of new and original recipes which can be passed as human made recipes. The dataset used for the model is Recipe 1M+ dataset. This model achieved an accuracy of 86%.	Automated and manual validation techniques was used for text generated by language models. Additional techniques used included web scraping and exploratory data analysis.
RecipeNet: Image to Recipe/Nutritional information generator. Dorian Raboy-McGowan, Sabrina Lu, Luciano Gonzalez. Published in: Semantic Scholar(2020).	First extract the image representation with a DenseNet-50 encoder and obtain the ingredient embedding using a decoder architecture to predict ingredients.	This recipe generation system takes a food image as an input and outputs a sequence of cooking instructions. The dataset used in this model is Recipe 1M dataset. The cosine loss of this model is 0.719.	This system mainly consists of 3 layers, food understanding-where it identifies the type of food in the image, classification-classifies different food items, text generation-generates the conditional text based on the recipe.

Inverse Cooking: Recipe Generation from Food Images. Amaia Salvador, Michal Drozdzal, Xavier Giro-i-Nieto, Adriana Romero- Published in: IEEE(2020)	The image is encoded from the dataset using CNN, ResNet-50, ResNet-101, and DenseNet-121, each trained on the ImageNet dataset. This system takes the input as an food image and generates the recipe and ingredients.	This even gives the approximate content of calories and nutrition value in that food. The dataset used in this model is Recipe 1M dataset. It achieved: recall of 75.47%, precision: 77.13% and accuracy of 55.47%.	As this uses an complex algorithm of ResNet and DenseNet, the time and computing power utilization is high, thus resulting in higher accuracy and low validation errors but consuming more time and power
Food Recipe Recommendation Based on Ingredients Detection Using Deep Learning. Md. Shafaat Jamil Rokon, Md Kishor Morol, Ishra Binte Hasan, A. M. Saif, Rafid Hussain Khan. Published in: ICCA(2022)	They used CNN for identifying 32 different types of ingredients. They used pre trained model called ResNet50.	The dataset used is food 101, fruit 360 and UECfood 256. After running 20 epochs using transfer learning, the proposed CN-based ResNet50 model attained: 99.71% accuracy for the training dataset, 92.6% accuracy on the validation dataset.	It can identify only 32 ingredients. CNN model cannot classify multiple objects. It means that model that model can identify only ingredient at a time.
Recipe Generator using Deep Learning- Disha Moolya1, Sakshi Pansare2, Anushree Kshirsagar3, Prof. Sonali Bodekar-Kale4 Published in: IJRASET(2022)	Natural Language generation has used to produce text from data which use LSTM version of RNN. It Remembers the data for a longer period and can remember or forget the information according to the importance.	The dataset used in this model is from Epicurious and recipe box. They used Adam optimizer with 500 epochs and learning rate of 0.0005. It gave least loss. Once ideal parameters were set and valid output generated by the model, it was deployed into a web application.	They did not use any pretrained models for text generation. They can add one features like search by image and search by cuisine type. They can improve their project making recipe generation from title, rather than giving ingredients.

1.4 Existing system

- In the existing systems the pretrained models have been utilized for the generation of the texts for the recipes.
- The models used for discerning the recipes perform the operation one at a time rather than all of them together performing simultaneously.
- Some models make use of Resnet and Densenet which increases the requirement for generating the output and power of computing resources used is high.
- There are few existing projects which make use of identification of images based on CNN model and extracts the features from the images and generate the possible recipes.

1.5 Proposed system

- The main framework used in this model are Tensorflow and keras.
- Our project aims to provide different combination of recipes based on the ingredients provided by the user.
- The dataset used in this project contains more than 2 Lakh data entries. This is helpful to create output based on the ingredients given.
- The recipes have different lengths. We need to have one hard-coded sequence length limit before feeding recipe sequences to RNN. We need to find out what recipe length will cover most of the recipe use-cases, and at the same time, we want to keep it as small as possible to speed up the training process.
- The ingredients specified by the users will be a key component in the system and our model generates the output as an recipe.
- We have used character-level language model based on multi-layer LSTM (Long Short-Term Memory) network (as opposed to the word-level language model). This means that instead of creating unique indices for words, we will create unique indices for characters. By doing that we let the network predict the next character instead of the next word in a sequence.

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SYSTEM REQUIREMENTS

2.1 Hardware requirements

- 4GB RAM (8GB preferable)
- x86 64-bit CPU (Intel / AMD architecture)
- 1Gb free disk space

2.2 Software requirements

- Linux- Ubuntu 16.04 to 17.10 OR Windows 7 to 10
- Python 3.6 or above
- Jupyter notebook or Google Colab or Microsoft Azure

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SYSTEM DESIGN

3.1 System architecture

- This project is based on recipe generation so we have utilized the datasets pertaining the recipes of all the different varieties of food. We have also made use of the datasets of food images to generate the recipes.
- We have applied multiple deep learning algorithms to fulfil our objectives. The algorithms used include RNN, CNN, NLP and LSTM.
- RNN has been used for the objective of generation of recipes, CNN has been applied for classifying and recognizing food items and LSTM is used to store the output of the previous layers.
- The system consists of utilizing all the datasets pertaining to the ingredients to generate recipes befitting of the ingredients which have been specified.

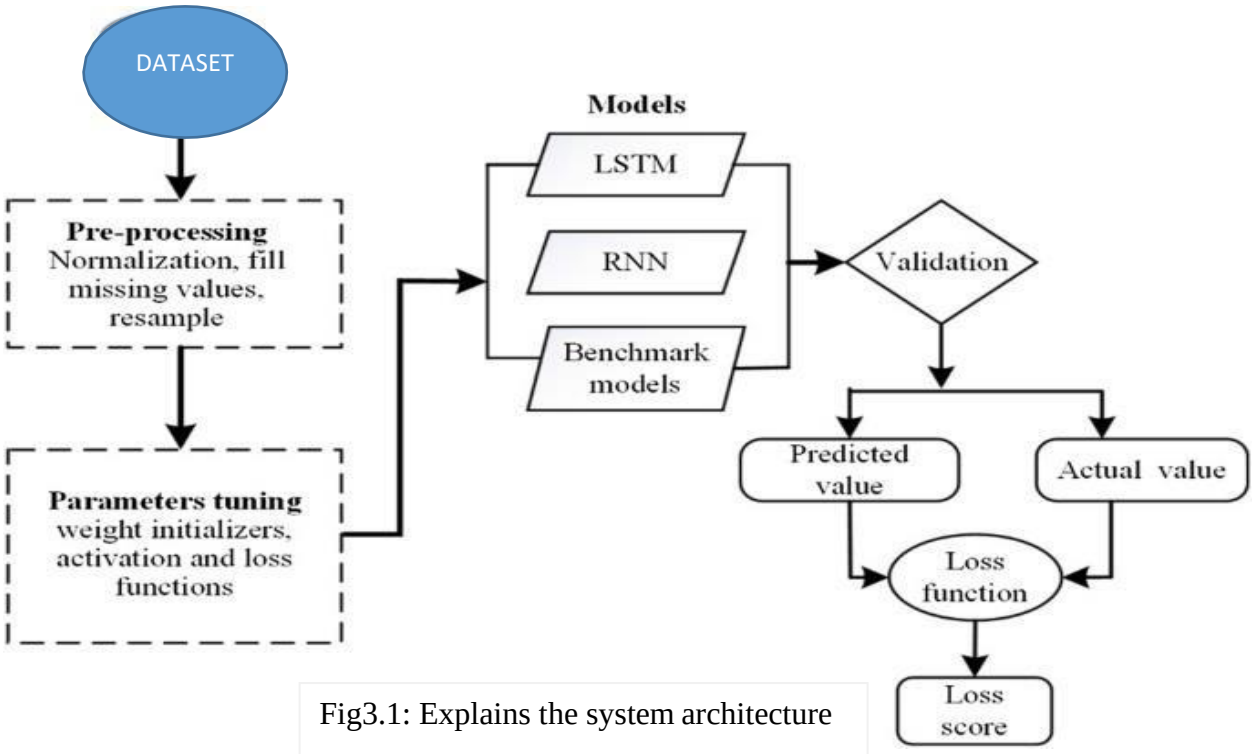

Fig3.1: Explains the system architecture

3.2 Flowchart

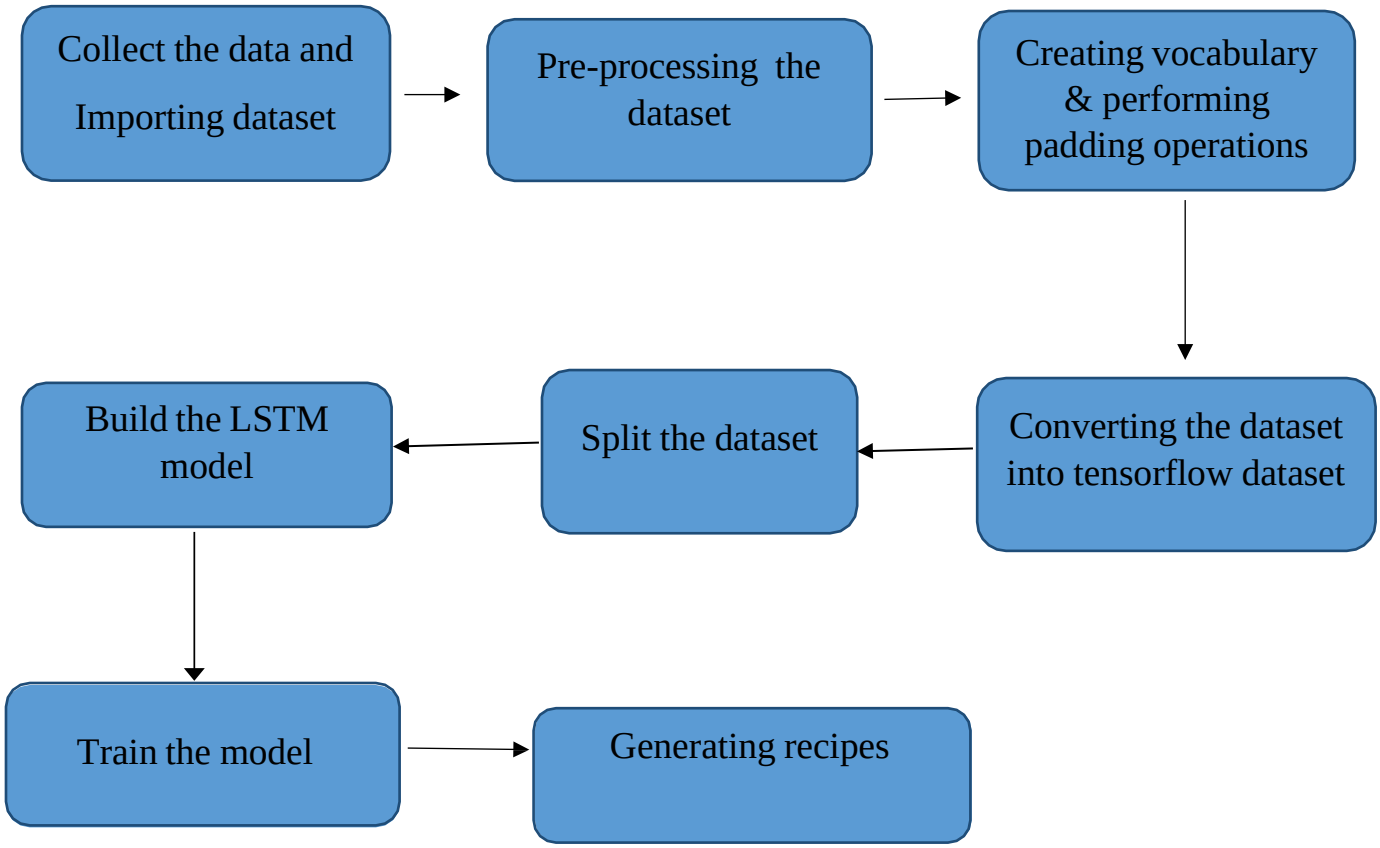

Fig 3.2.1 It explains flow of our model.

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IMPLEMENTATION

4.1 Pseudocode

- We have deployed our project in Microsoft Azure on a virtual machine having Nvidia GPU and 56GB RAM to train our model.
- Importing the recipe dataset and preprocessing the dataset by removing null values and cleaning the data.
- Then creating the vocabulary framework for the next prediction and performing padding operations so that every input is made of same size.
- Converting the numpy dataset into tensorflow dataset to make use of operations which are exclusively provided by the tensorflow and not by numpy.
- Splitting of the dataset into training and testing sets and building the LSTM model by creating a total of 5 layers.
- Then training our model with 500 epochs and steps per epoch is 1500 iterations so that the model is trained rigorously for all types of ingredients.
- Finally, we got a loss of 1.2134 and there was no improvement in the loss so there was an early stopping at 9^{th} epoch which resulted in avoiding the overfitting of model.
- At last inputting the ingredients to generate different combinations of recipes based on the user input.

CHAPTER-

RESULTS AND DISCUSSIONS

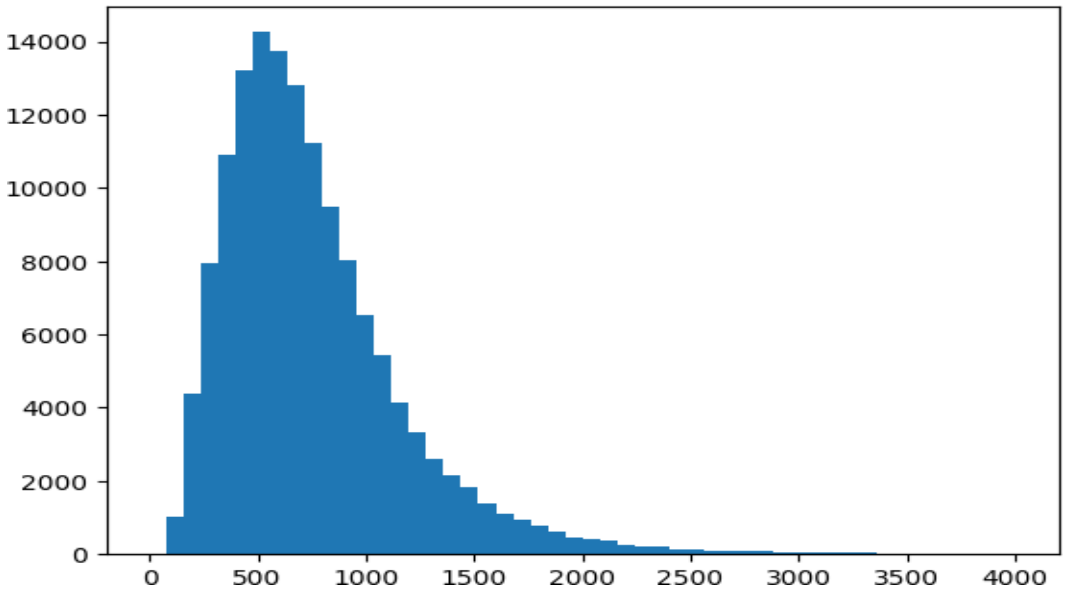

Fig 5.1 shows length of recipes from range 0 to 4000.

```
items = [
    "flour,chilli,potato,paneer,tomato,onion"
]
```

Fig 5.2 shows ingredients to generate recipe.

[TITLE]: Chilli tikka masala

[INGREDIENTS]:

- 1: 3 cup all purpose flour
- 2: 2 cup chilli
- 3: 1 cup tandoori cubes
- 4: 2 cup small potato
- 5: 1 can paneer
- 6: 2 small slice tomato
- 7: 1 1/2 small onion

[DIRECTIONS]:

- 1: Dice the tandoori and stir fry with 2 cups of water.
- 2: Then simmer the chilli and the tandoori until they are soft.
- 3: Add 1 cup of water, then add 1 cup of flour, then let it boil.
- 4: Add 1/2 cup of water and make a soft dough.
- 5: Knead with your hands, adding flour as required.
- 6: Put in a bowl, cover, and let it rest for 30 minutes.
- 7: Divide the dough into 3 parts.
- 8: Roll out, and then cut into rectangles.
- 9: Spread one quarter of the flour nan in the middle and fold it over, like a taco, leaving a long side in the middle.
- 10: Take the seam off, and transfer onto a plate.
- 11: Make sure there is enough space between each rectangle.
- 12: Preheat the frying pan, and add the 2 tablespoons of oil.
- 13: Carefully place the tikkas in the frying pan, and fry on one side until golden brown, and turn them over.
- 14: Remove, and drain on paper towels.
- 15: Add 1 cup of water to a pan, and reduce to half, and stir in the can of tomtoes.
- 16: Add the onion and the tahina to taste, and let it cook.
- 17: Remove from heat.
- 18: Put the tikkas in an oven safe dish, and heat it in the oven.

Fig 5.3 shows generated recipe of Chili tikka masala

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CONCLUSION AND FUTURE ENHANCEMENT

- From this project we can conclude that the role of food is extremely paramount in our daily lives and it shows us how to make recipes which can help us in this regard.
- The project also concludes that the use of deep learning algorithms can be used in the field of cooking efficiently thereby increasing the effectiveness and eliminating the need for extra human interactions.
- We can also see that the food recipes generated can be easily generated and can be used to prepare meals based on the convenience of the users.
- Future enhancements of our project can include the option of generating recipes from the input consisting of images. This can include a system where only an image of a food item can lead to the generation of the recipes.
- Another future enhancement in our project can be to convert our project into a website and upload newer recipes frequently to increase the size of the recipes generated.
- We would like to add a feature which calculates the calorie count of the dish prepared which can be helpful for the calorie conscious.
- We also would like to add search by cuisine feature which consists of multiple cuisines from all parts of the world.
- Another feature would be adding different recipes for separate diets consisting of vegetarian or non-vegetarian and so on.

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