# Vision Based Intelligent Recipe Recommendation System

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**ABSTRACT**

In a world where busy lifestyles often leave little time for meal planning and preparation, there's a growing need for innovative solutions that help individuals make healthier choices and utilize the ingredients they have at home efficiently. Therefore, it is proposed to develop a recipe recommendation system through image recognition of food ingredients[1]. Till today's date this system is a mobile application which will recognize an image provided by any user and recommends recipes based on the recognized ingredients from the image. Using the art of PyTorch deep learning model, it offers a unique combination of food detection and recipe generation. Whether you're wondering what to do with that random vegetable you picked up at the market or you want to make the most of your pantry, this app has you covered with the power of cutting-edge PyTorch deep learning models, It also allows you to identify fruits or vegetables with a simple snap of your camera. Say goodbye to mystery produce items and hello to a deeper understanding of your ingredients. Based on the ingredients you've identified or searched for, It will you offers a curated selection of recipes. From vibrant salads to hearty stews, each recipe is handpicked to showcase the natural flavors and nutritional benefits of the ingredients involved.

**Keywords:** Ingredients recognition, artificial intelligence, machine learning, Pytorch, datasets, fruits and vegetable detection, recipe recommendation, i m a g e processing.

## 1. INTRODUCTION:

For most Indian women, the day in the office is well over but the day certainly does not end there. They also have to make some dinner for the family. The next inescapable question that beckons them is: "What to cook today?". The proposed system will automatically identify the vegetable with which half dish can cook and suggest various amazing dishes. This is achieved with the magic of computer vision [2]a, users can effortlessly capture or upload images of vegetables, allowing the app to identify them accurately. Say goodbye to the mystery of unknown vegetables in your pantry! Once it identifies the vegetable, it opens the door to a treasure trove of culinary delights. The extensive database houses a collection of recipes tailored to each vegetable, ensuring that you receive recipes that not only match your ingredient but also tantalize your taste buds. No need to browse through endless lists. It will simplify the recipe search

process with an intuitive search bar. Just type in the name of your favorite vegetable, and watch as a world of recipes unfolds before you, ready to inspire your next culinary masterpiece. The paper introduces the introduction to the topic and Related works in detail and working of the proposed system successively. It also contains the algorithm, which has been proposed for its implementation. The User Interface for the proposed system is discussed alongside few case scenarios. Conclusion and future scope is mentioned at the end of section of the paper.

## 2. RELATED WORK:

In this paper the technique used to detect the images of fruits and vegetables is Pytorch, Why Pytorch? Since PyTorch is popular for dynamic computation graphs and flexibility while developing a model. This feature makes it easier to debug and modify models on the fly, facilitating rapid experimentation and iteration. Developers find PyTorch's syntax more intuitive compared to other frameworks like TensorFlow, which can speed up the development process significantly [3]. The language used in Pytorch is Python that makes it easy to understand the coding environment. PyTorch gives you access to many pre-trained models that have already been trained on large datasets like ImageNet. These models include state-of-the-art architectures such as VGG, ResNet, and Inception, which can be easily fine-tuned for specific image classification tasks. This capability allows developers to leverage existing work and achieve high accuracy with minimal effort [4]. The datasets that is used for training contains a wide variety of fruits and vegetables classes, it has aroud 40 group of classes each. The Recipes are fetched from the real time database that has 10000+ recipes allowing a wide range of recipes recommendations to the user. It also allows the users to type their ingredients and get recipe according to it.[5]

## 3. LITERATURE SURVEY:

PyTorch, regarded as a framework with great flexibility and ease of use, particularly for research and development purposes. It allows for dynamic computation graphs, which are beneficial for building complex neural networks. The integration of machine learning and computer vision technologies for everyday tasks has seen substantial growth, driven by the increasing capabilities of frameworks like PyTorch. One such application is the automatic identification of fruits and vegetables and suggesting relevant recipes based on the identified items. This literature review explores existing research and methodologies for building such a system, focusing on image processing, object detection, and machine learning algorithms.

### Image Processing and Object Detection Techniques:

Image processing is crucial in transforming images into a format suitable for machine learning algorithms. Techniques like color histogram comparison, texture classification, and gray level thresholding are commonly employed for object detection and identification.

1. **Histogram Comparison**: Histogram comparison involves converting images into HSV (Hue, Saturation, Value) color space to minimize illumination effects.

The color histograms of the input image are compared with those in the trained database to find a match[2] .

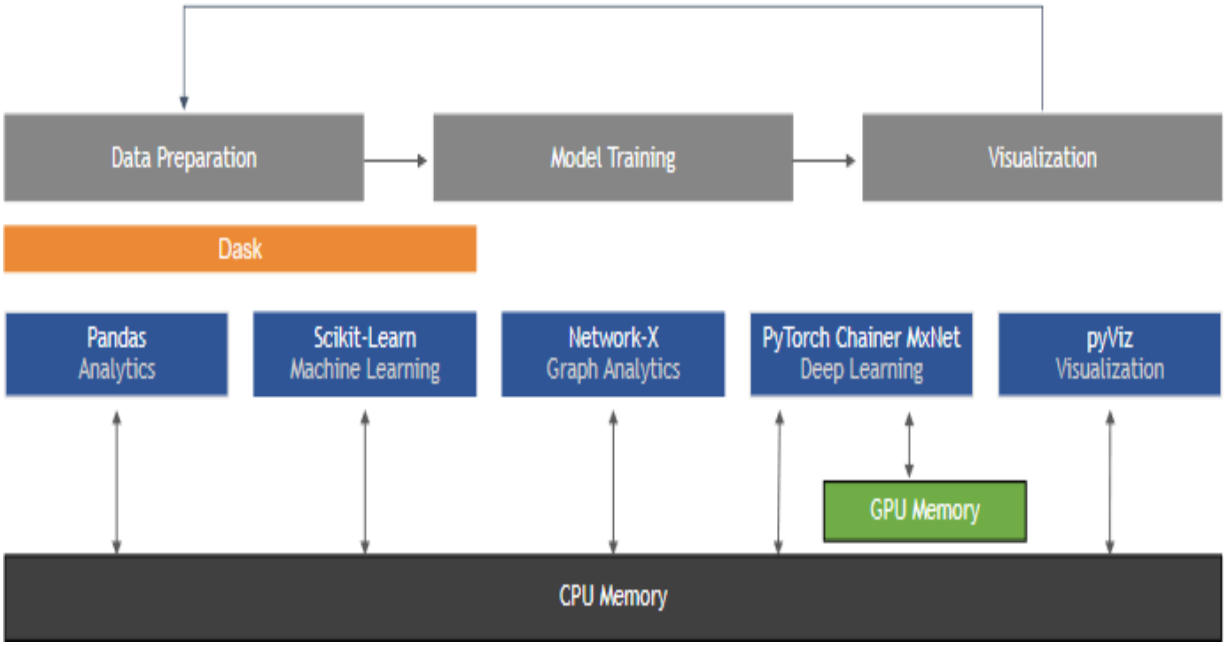
2. **Texture Classification**: Texture classification helps in distinguishing between objects that belong to the same parent class but differ in finer details. Small blobs are removed, and connected

   component size is computed using gray level thresholding.

   This technique helps in identifying child classes within the parent class, such as distinguishing between zucchini and beans based on their texture and shape[2].

**Scientific Computation and Machine Learning using Python:**

Like Pandas, the first version of NumPy (under its former name, "Numeric") came out more than 25 years ago, but also is still actively developed and maintained. In 2017, the Moore Foundation awarded the NumPy development team a $645,000 grant to support its continued evolution and ongoing care. As of this writing, Pandas, NumPy, and SciPy remain the most user-friendly and recommended choices for many data science and computing projects[6].




(The standard Python ecosystem for machine learning, data science, and scientific computing[6])

**Case Studies and User Interface:**

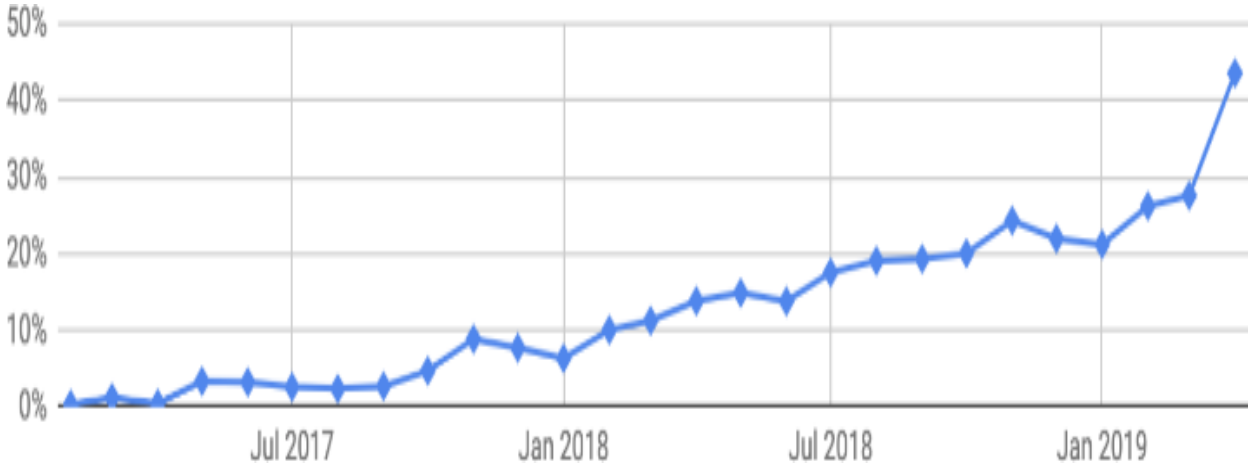
Practical implementations of these systems demonstrate their effectiveness and usability.

1. **User Interface**: A user-friendly interface typically involves screens for uploading images, displaying identified vegetables, and showing suggested recipes. The system's accuracy in identifying vegetables and providing relevant recipes can significantly enhance user experience[2].

2. **Accuracy and Performance**: Experimental results show high accuracy rates in vegetable identification, with some systems achieving up to 96.55% accuracy. This ensures reliable performance in real-world applications[2].

**Adoption:**

The validity of design decisions and its impact on ease-of-use is really hard to measure. As a rough proxy for the reception of PyTorch in the machine learning community, we tried to tally the mentions these and a few other machine learning tools (Caffe, Chainer, CNTK, Keras, MXNet, PyTorch, TensorFlow, and Theano) have received on arXiv e-Prints since PyTorch was released in January of 2017. In the graphbelow we report the monthly number of mentions of the word "PyTorch" as a percentage of all mentions among these deep learning frameworks.[4]




(Graph from [4])

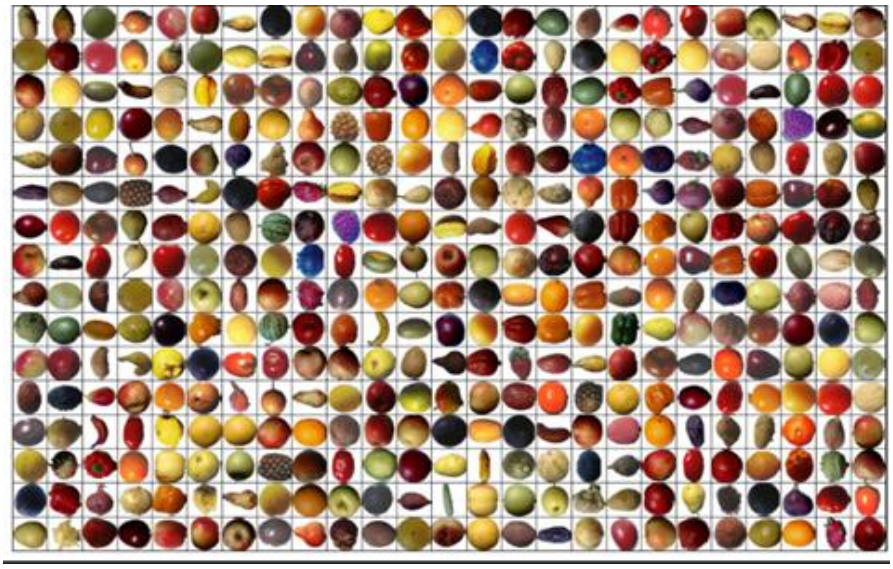
## 4. PROPOSED SYSTEM:

The key Function of the system is to detect the imagery of fruits and vegetable through live camera.
The author of 4 usefully notes that PyTorch has gained popularity in the deep learning research community by balancing an emphasis on ease-of-use with performance attention to detail.

In addition to continuing to support the latest trends and advances in deep learning, in the future we plan to continue to improve the speed and scalability of PyTorch.The vegetable and fruit recognition system can recognize, analyze and process the images by performing different steps they are as follows:

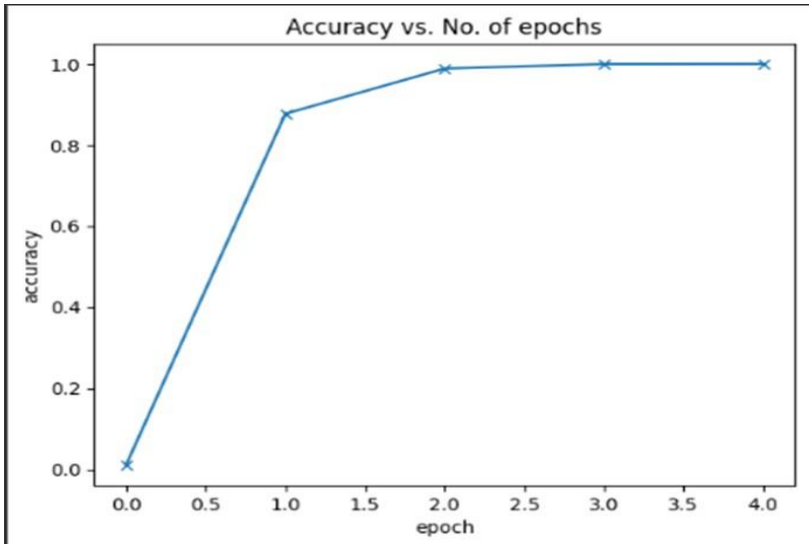
1. **Import Libraries:** Import necessary libraries such as PyTorch and any relevant modules.

2. **Load and Preprocess Data:** Use DataLoader to load the dataset and apply transformations (e.g., normalization).(Figure 1)



3. **Define the Model:** Create a neural network by sub classing torch.nn.Module and defining the architecture.
4. **Specify Loss Function and Optimizer:** Choose an appropriate loss function (e.g., CrossEntropyLoss) and an optimizer (e.g., Adam)[7].
5. **Training Loop:**

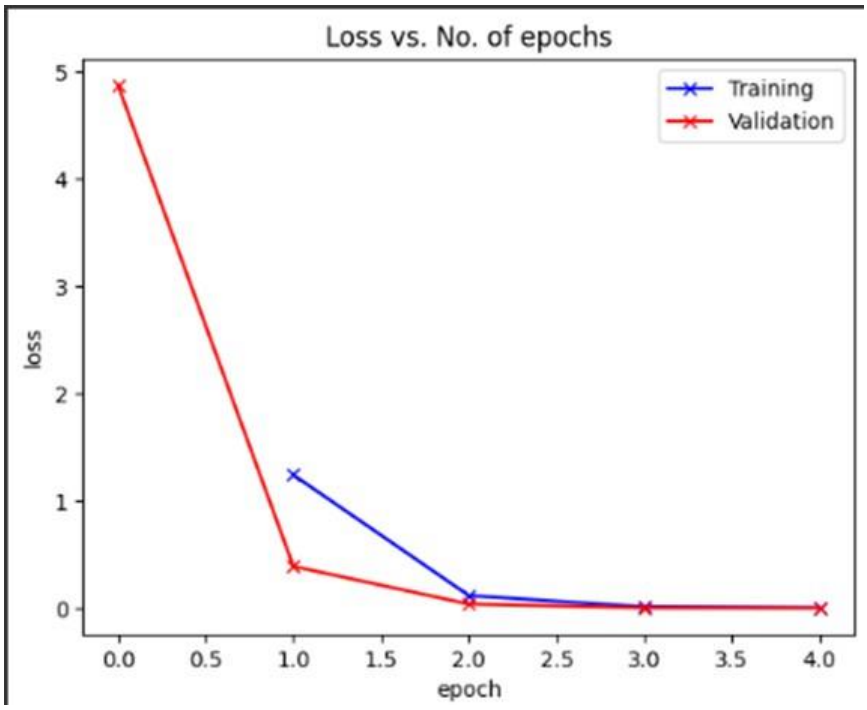
i. Iterate over the dataset:




(Figure 2)

ii. Perform forward passes.

iii. Calculate the loss.

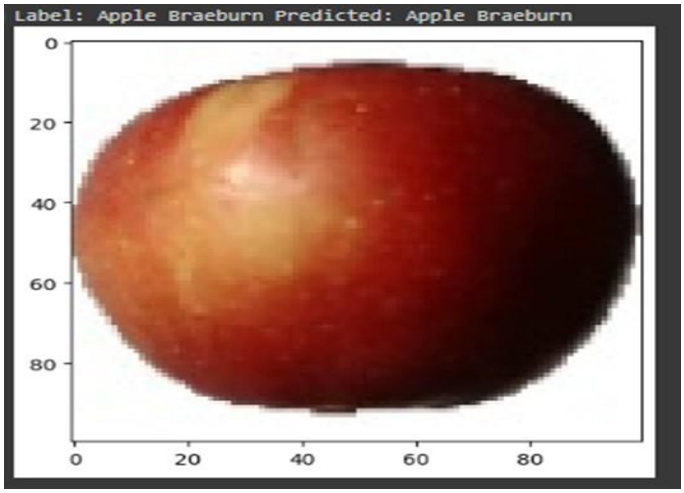



(Figure 3)

iv. Back propagate the gradients.

v. Update model parameters.

6. **Evaluate the Model:** Test the model on a validation or test dataset to assess performance.

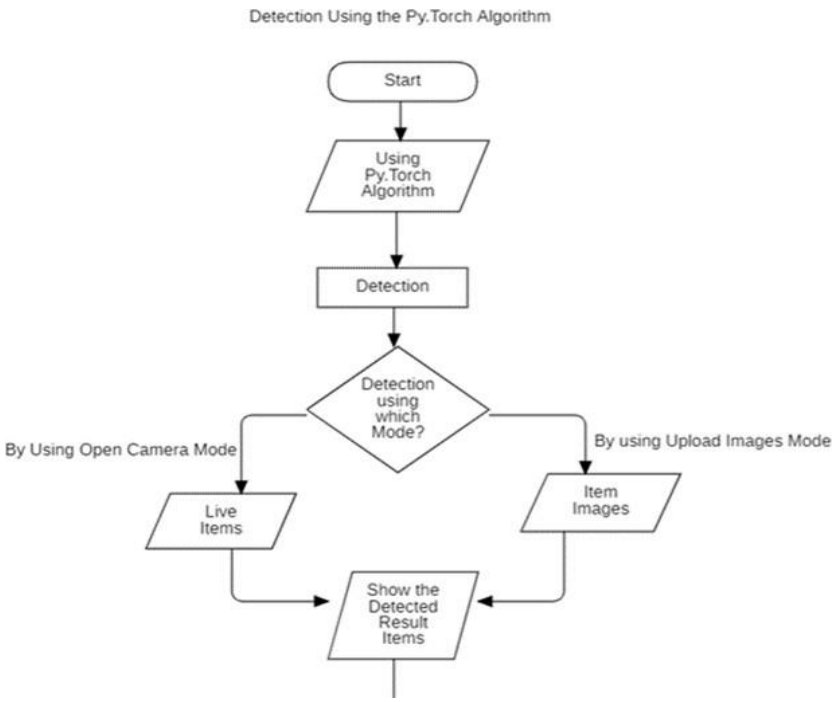



(Figure 4)

7. **Save the Model (Optional):** Save the trained model for future use.

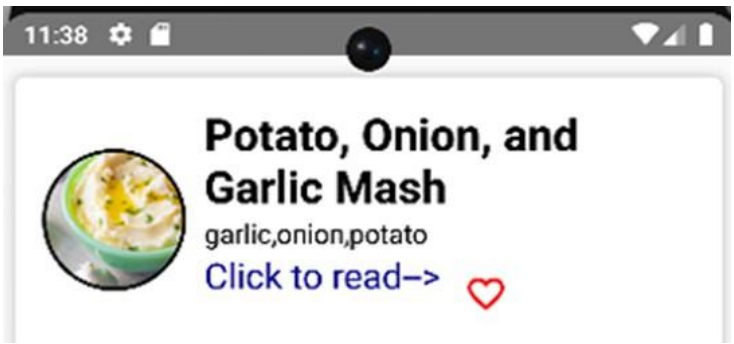
**4.1 Flow chart of the application:**

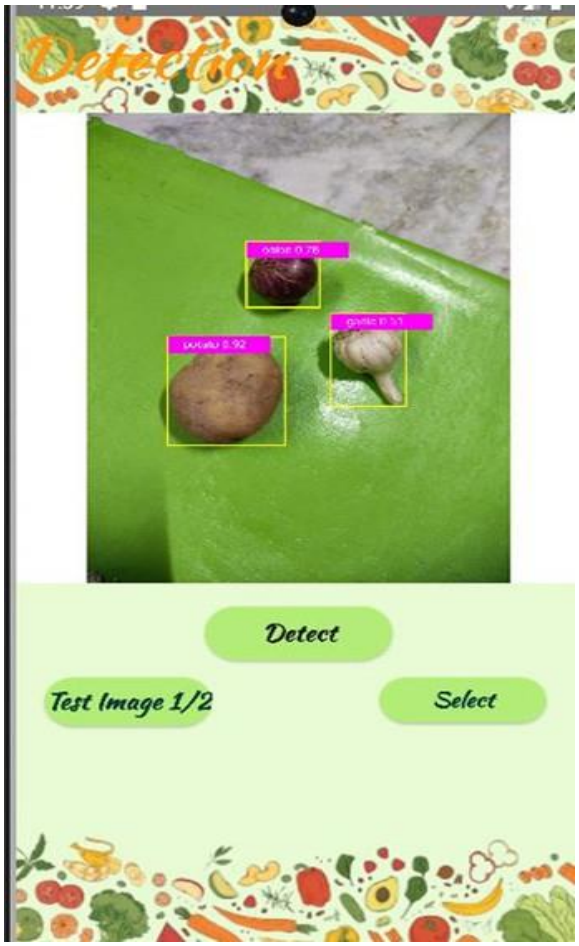
(Figure 5: Flow Chart)

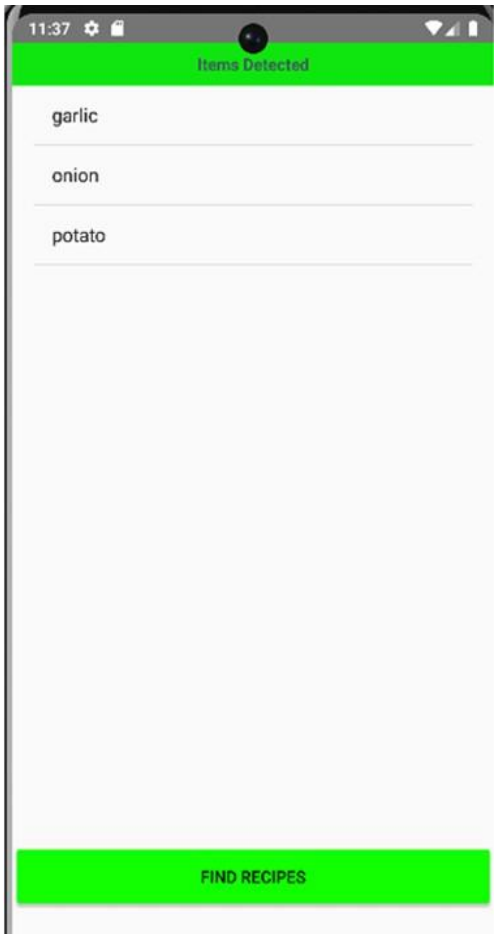



```
FirebaseDatabase.getInstance().getReference().child("Recipes")
.addValueEventListener(new ValueEventListener() {
@Override
public void onDataChange(@NonNull DataSnapshot dataSnapshot)
{ for (DataSnapshot snapshot : dataSnapshot.getChildren()) {
   MainModel recipe = snapshot.getValue(MainModel.class);
allRecipes.add(recipe);
}
}
```

**4.3 User Interface:**






### 4.4 Dataset:

Datasets are examples of specific databases who will be used to train the algorithms for Artificial Intelligence or for other types of Data Science projects.
Choosing the appropriate dataset is critically important for training a model that generates results closest to the truth.
Specifically, when looking through scientific studies on related topics, it was noted that the Food-101 dataset is a common one.
However, it contains a lot of entries (~10000+) and since it mostly contains images of prepared recipes, it does not really help with the project goal of using only very simple and recognizable ingredients.
Therefore, a search for alternative datasets was conducted, and the "Fruits and Vegetables Image Recognition Dataset," available on the Kaggle website, was found to be more relevant to the project's objectives [8].
However, it restricts the range of ingredients to fruits and vegetables only [3].


(Figure 6:- Dataset folders)


(Figure 7:- Folders of the dataset classes)

Training and validation: Provide labeled samples for model learning and evaluation. Diversity: Expose models to various scenarios, improving generalization.
Data augmentation: Artificially increase dataset size, enhancing robustness. Benchmarking: Standardize conditions for comparing model performance.

Research: Enable testing of new algorithms and driving innovation.
Datasets are essential for training effective image identification models, facilitating learning, evaluation, and advancements in computer vision.

## 5. EXISTING SYSTEM:

• **Plant Snap:** Plant Snap is a mobile app that helps users identify plants, including fruits and vegetables, using visual recognition technology. It provides information about the plant's species, habitat, and uses. While it doesn't provide recipes directly, it could serve as a helpful tool for identifying plants and finding recipes elsewhere.

• **Yummly:** Yummly is an application in your device for recipes based on information taken from the user preferences and what is in their pantries to create appropriate recipe suggestions. Though the recipes through Yummly don't particularly cater towards fruits and vegetables alone, recipes involving fruits and vegetables do appear.

• **All Recipes:** All Recipes is a popular recipe app that offers a vast collection of recipes, including those that feature fruits and vegetables. It also provides a search filter where you can specifically look for vegetarian recipes or recipes that include certain fruits or vegetables.

• **Smart Refrigerator:** Converting the old-fashioned refrigerator to smart and intelligent using Arduino UNO and Python. The module can detect the deficiency of any food item within it, which also makes the owner/user aware about this problem, uploads the data into the sql server, and gives information related to the fridge temperature and humidity. Google API can be used for object recognition based on natural language processing algorithms and strong neural networks to recognize the commands given to give responses. User Apps directly connected with server which shows real time contents of freeze also user suggested the recipes as per availability of vegetables.[9]

## 6. LIMITATION:

• Android Studio is able to work with limited datasets.
• Foreign fruits or vegetable may not be detected as the dataset is unavailable.
• Users can not add their own recipes.

## 7. FUTURE SCOPE:

• Increasing the size of datasets by adding more variety of fruits and vegetables.
• Increasing the number of recipe list by adding foreign cuisines as well [10].
• Users can add their own recipes to share it globally.
• Can be made to work on ISO platform if needed.

## 8. CONCLUSION:

This application is pretty handy and useful for cooking variety of recipe with minimum search effort from the internet. Internet recipe may appeal to one but not to the other, some people like experimenting and trying own recipes. It will help people save their time and energy finding recipes for daily routine as well as for special occasions. And because it is a mobile application, users have freedom to find recipes where they are, and save later.
Suitable for use from very diversely different kind of user who may seek to find novel recipe so that cook for their children, may be restaurant owner looking out to have a new thing to offer in their menu, anybody doing normal cooking.
This paper presented a Pytorch model to recognize food ingredients and a recipe recommendation algorithm based on detected ingredients to suggest cooking recipes [11]. We also introduced a custom dataset of 32 categories of food ingredients. We achieved a testing accuracy of 94%, which is quite impressive, and proved that the performance of this model in recognizing food ingredients from images is more advanced. Because of these high accuracy levels, we found Pytorch very appropriate for food ingredients recognition.

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