Real time Product Detection

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Abstract

There has been a creation of large number of datasets on object recognitions, but the groceries dataset is a less explored dataset mainly due to fewer variety of instances. However, a research group from the University of Freiburg came up with a complete grocery items image dataset. This opened opportunities for analysis and classification of those grocery items into different classes. Machine learning based approach can be used to distinguish between different classes which is a key requirement of autonomous robotic operations. In the state of the art, CNN is used with a greedy algorithm to classify the grocery items. In order to increase the accuracy, hierarchical CNN with Reinforced Learning algorithm can be used. This avoids misclassification when the classes are more. Along with the new algorithm, if hyper-parameter optimization is done, the prediction rate of the model can be increased, and the processing time can be reduced. Apart from increasing the detection accuracy, a diet calculator can also be provided which displays the contents of the package once its class is identified. After identifying an item, further analysis can be done on comparison of different brands of this particular item. This gives an idea of which brand is cheaper.

1. Introduction

The ability to classify objects after object recognition is one of the most challenging and important problem. The object recognition is done using computer vision and classifying the object into a particular class is done using different machine learning approaches.

1.1. Motivation: The improvement in the technology can be used for the betterment of the society. The elderly people or the physically challenged have always had the problem of going around the supermarket and buying the things needed. Instead, a machine doing all this will surely help people. Therefore, a well-trained machine will surely identify the required items and help people in need.

1.2. Challenges/Problem Statement: There had been no much improvement done in this field as a dataset having a lot of categories was not available. Moreover, as most of the datasets were privately owned, there was no access to it. But later a new dataset- Freiburg Groceries was released that is available for all. Due to it vast categories and due to its multiple classes of items, a lot of research can be done in this field. The current challenges faced are: The products with white or plain packaging are mis-classified as flour. When there are multiple classes of an item, there is no correct classification. The network performed well on water or juice category but it failed to recognize the category of flour. This came into limelight from the research carried out in "*The Freiburg Groceries Dataset*". The increase in computational/processing time and average prediction accuracy is a drawback of the research done by "*Classifying food items by image using Convolutional Neural Networks*". The aim of this research is to increase the prediction accuracy

using different algorithms, hyper-parameter optimization and also visually represent different brands of products for each category and distribute them as per the cost. In addition to this, a chart showing the calorie content present in the item too can be shown.

1.3. Research questions: The research questions are as follows:

1.3.1. How to extract more data for analysis?

1.3.2. How to increase the performance of the model?

1.3.3. How to come up with solutions for the limitations of the previous research done?

1.3.4. How to visually explore the different calorie contents of products?

2. State of the Art

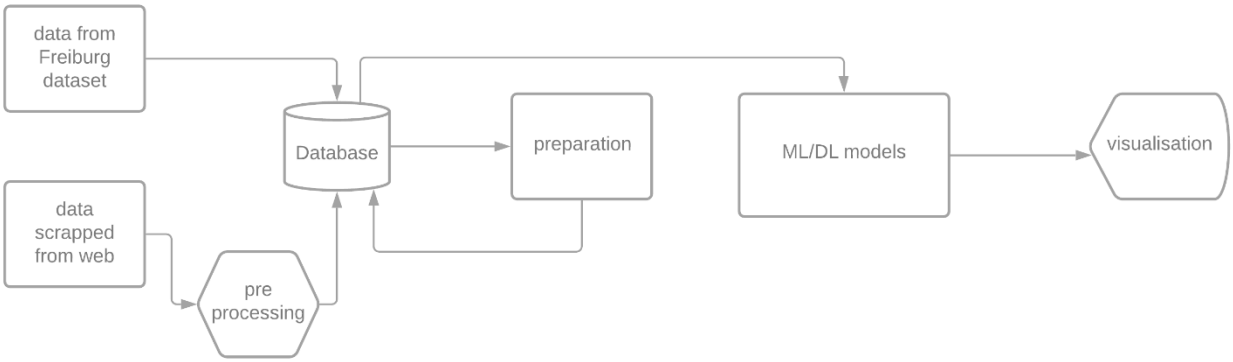
According to the research carried on in "The Freiburg Groceries Dataset", the CNN model with CaffeNet architecture was used with five convolution layers and three fully connected layers and had the prediction accuracy of 78.9%. Here, the images were partitioned into five equally sized splits, with the images of each class uniformly distributed over the splits. The drawbacks of this model were that the products with white, plain packaging were mis-classified as flour. The model performed well on water, jam and juice classes but failed to recognize the flour category. The evaluation of multiple classes based on the single class data did not provide accurate results.

The limitation regarding the prediction accuracy was improved by the research conducted by Derek Farren, "Classifying food items by image using Convolutional Neural Networks". Layers were added to improve the performance of the model. The performance of the model increased by 11%. Here, guided pruning algorithm was used to improve the model's accuracy step by step. This increased the computation time. Hyperparameter optimization was not considered and there was no usage of reinforced learning algorithm.

3. Expected Outcome of your Thesis

The main aim is to improve the performance of the model so that the prediction accuracy increases along with overcoming the limitations mentioned previously. The more the data, better the classification of images. The addition of new images will improve the performance if the model. The add-on's to this are addition of a new database that has calories' content present for each item/class and also the cost of each item. The comparison of costs and calorie values of different brands can be visualized. This provides the user with an opportunity to have a preference.

4. Proposed Method/Architecture

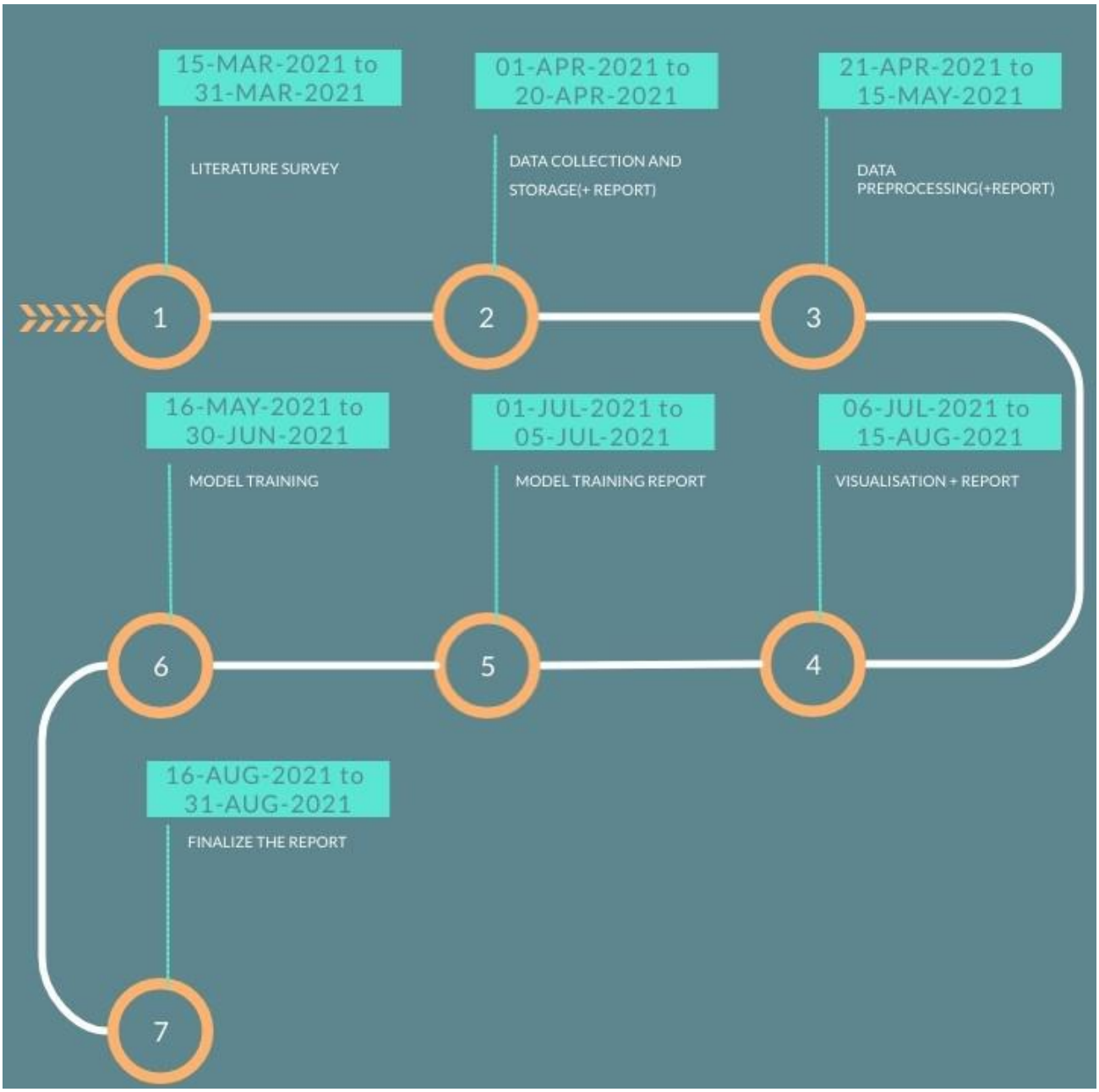


In the proposed architecture, the data from Freiburg dataset is stored in the database and the web scraped data is preprocessed to have the same pixel format as that of the Freiburg data. Then, this data is stored in database. Once this step is done, the untagged data is tagged and the entire data is balanced in the data preparation step. After balancing, the data is passed to models for training and the predicted results are further sent for visualization

5. Evaluation

The evaluation of the deep learning models with different architecture can be done by how accurately the items are being classified followed by its precision, recall and F1 score. Also, different customers/users can be told to perform the evaluation and get desired feedback from their end so that the model can be improved.

6. Timeline



7. Bibliography

- Derek Farren, "*Classifying food items by image using Convolutional Neural Networks*"
- Philipp Jund, Nichola Abdo, Andreas Eitel, Wolfram Burgard, "*The Freiburg Groceries Dataset*"