

# Implementation of Convolutional Neural Network (CNN) Method for Fish Processed Cuisine Image Identification Application with Google Maps Features

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## ABSTRACT

The rapid advancement of science and technology encourages dynamic transformation in various sectors, especially in the field of information and communication technology (ICT), especially with the existence of Android-based smartphones. This advancement revolutionizes the way we access information, especially about various processed fish dishes in Indonesia. However, despite the plethora of culinary offerings, travelers often find it difficult to discover traditional dishes through social media platforms. To bridge this gap, a new app that utilizes artificial neural networks has been developed. The app allows users to photograph and upload images of processed fish dishes to recognize and provide detailed descriptions and recipes. In addition, integrating Google Maps makes it easy for users to find nearby places that serve these dishes. Testing the app with a dataset consisting of 1577 images of six types of processed fish dishes yielded promising results, with accuracy reaching 97.57% over 120 epochs. This innovation not only preserves cultural heritage but also enhances the culinary experience for locals and tourists.

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## 1. INTRODUCTION

The development of science and technology is currently very rapid bringing dynamic changes in various sectors, especially in the field of information and communication technology including the use of Android-based smartphones. The development of information technology causes human dependence on information technology to get higher. Humans become consumers of information and also produce information. In this case, information technology is widely used, one of which is to find culinary information or local food, using

the help of mobile smartphones which can now find out various local foods in Indonesia [1].

Indonesia as one of the archipelagic countries strives to become one of the world's tourist destinations and continues to strive to improve itself to compete with other countries. The Law of the Republic of Indonesia No.10 of 2009 concerning tourism states that tourism is a variety of tourism activities and is supported by various facilities and services provided by the community, entrepreneurs, government, and local

governments, one of which is culinary tourism. Culinary tourism is a travel experience to a gastronomic area for recreational or entertainment purposes, which includes visits to primary and secondary food producers, festivals, food exhibitions, events, farmers' markets, cooking events and demonstrations, tasting quality food products, or food-related tourism activities [2].

Indonesian traditional cuisine is very diverse, along with the diverse ethnicities and multicultures that exist in Indonesia. Many foreign and domestic tourists who are on holiday to areas in Indonesia are curious about the various types of processed fish dishes that are commonly found at that time, so it is unfortunate if the enormous cultural potential of this processed fish cuisine is wasted. Sometimes through social media through smartphones, it is also still difficult to recognize traditional processed fish dishes in the area.

To overcome these problems, as an effort to introduce Indonesian processed fish dishes that can be recognized by tourists, here researchers have created a mobile application system design that will be able to classify processed fish dishes using the convolutional neural network (CNN) method. The CNN feature used is Object Detection, a computer vision technique that allows one to identify and locate objects in images or videos. By identifying and determining where the processed fish dish is located, object detection can be used to determine and track the location in an accurate position, while accurately labeling it [3]. The CNN method is a further development of the multi-layer perceptron (MLP) because it uses a similar method with more dimensions. The CNN method is more widely used than the MLP method because the CNN method has a high network depth and is often applied to image recognition data so that it can produce a higher level of accuracy. The MLP method does not store spatial information from image recognition data and assumes that each pixel is an independent feature, resulting in poor results [4].

In this research, an application system is created that can use the convolutional neural network method to be able to recognize various types of processed fish dishes after the person concerned takes a photo and uploads the findings of processed fish dishes found, then a description and recipe for the name of the processed fish dish will be given. In addition, this application will also be equipped with Google Maps features to find out the location of the processed fish dishes closest to the user's place.

From this background, the purpose of this research is to implement the Convolutional Neural Network (CNN) method in an application to detect types of processed fish dishes. This research also aims to evaluate the accuracy of the CNN model in detecting processed fish images in the application. In addition, this research will explore the results of the functionality test of the image detection application of processed fish dishes implemented with the CNN model to ensure the effectiveness and reliability of the application in providing information on the type of processed fish dishes to users.

## 2. LITERATURE REVIEW

### 2.1 *Previous Research*

Some relevant previous studies include [1] which aims to facilitate access to information about various local foods with its benefits in expanding marketing and facilitating knowledge about local food as part of cultural heritage. Meanwhile, in [5], the development of increasingly modern table and chair designs was considered, focusing on the recognition of Jepara carving motifs through a system that uses the Convolutional Neural Network (CNN) method with an accuracy of up to 98% for detecting Jepara carving table and chair motifs in photos and videos.

In addition, there are several other studies related to this topic, such as [6], which aims to create an application that provides detailed information about kitchen spices through Augmented Reality technology with markerless image recognition. Another study, [7] explored the use of three different CNN

models to identify traditional Indonesian food by manually collecting data from the internet and achieving the highest accuracy of 83.82% for the Efficient NetV2M model. Research [8] resulted in the classification of traditional Indonesian food images with accuracy reaching 83.82% for the Efficient NetV2M model and 80.08% for the Efficient NetB6 model, using manually collected data from 1,202 different food images.

### 3. METHODS

#### Type of Research

The type of research that will be carried out is a type of development research where this research develops existing research. This research will discuss the research design in the form of system and application design, materials and tools used, and the determination of system procedures.

#### Research Stages

This research requires several stages of research starting from the design process until an application system is produced that can guess snacks according to the data. This research went through several detailed stages. The first stage involved a literature study on

image processing systems, Kotlin, and TensorFlow to design the system. The second stage includes data collection for the tools and research needs, including the software used in the creation of the system. The third stage involved designing the software using Android Studio as the application builder. Implementation, the fourth stage, involves testing the system to design results, with improvements where necessary. Analysis, the fifth stage, is conducted after successful implementation to analyze the test data. The final stage, the sixth, is report generation after obtaining the necessary data and analyses.

#### System Design

In this research, several tools and materials are required as listed. The required hardware includes a laptop or PC to perform Android programming, as well as a mobile phone as a medium for implementing the application created. Meanwhile, for software, Android Studio is used as the programming platform, Google Cloud Platform as the server of the created data, and MySQL as the database. The materials needed are processed fish images that will be input data for the application to be developed.

#### Block Diagram of the System

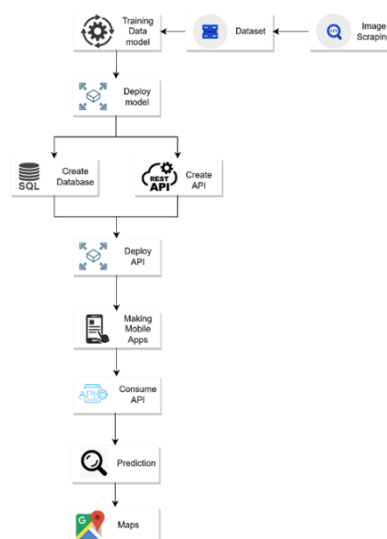


Figure 1. System block diagram

Based on the presented system block diagram, each block has its function. The first block, Data collecting (Image Scraping), is tasked with searching and collecting image data for datasets using web/image scraping

techniques. The second block, labeling the dataset according to the name of the processed fish, such as gulai ikan patin typical of Jambi or otak-otak typical of Riau Islands. The third block, creating the model

architecture and testing the dataset for accuracy, using mathpolib. Next, the prepared dataset is deployed into a database, which is the function of the fourth block. The fifth block involves creating private APIs for endpoints and Google Maps APIs for restaurant information. The APIs are then deployed, as done in the sixth block. The seventh and eighth blocks are the creation of the application and the placement of APIs in the application through the consume API process, including the Google Maps API and private API. Next, the ninth block is in charge of creating prediction features with prediction data taken from the API. Finally, the tenth block involves configuring Google Maps for restaurant search using the Google Maps service library.

### System Flowchart

After initiating the application, the user is asked to log in. If they do not have an account, registration can be done first, while if they already have an account, users can log in immediately. After successful login, the user is directed to the main page (home) to select various features available. One of the main features is prediction, where users can upload food photos to be processed by the system and get the results. Once the prediction is complete, the user will be directed to the predicted food detail page. Furthermore, there is maps feature that allows users to find out the location of restaurants or eating places

that provide these foods. If the user chooses the place to eat, the application will direct him through Google Maps as a guide to the place to eat, and finally, the user completes the process. Below is also provided a flowchart image of the prediction system to provide a further overview of the application's workflow.

After the images are collected, they are made into a dataset and labeled. The dataset is then tested to determine the accuracy level using Google Colab. Classification accuracy was evaluated using the area under the curve (AUC) and divided into five categories, namely Excellent classification (0.90 -1.00), Good classification (0.80 -0.90), and Fair classification (0.70 -0.80). If the accuracy rate reaches at least 80% or more, then the data can be considered by the reference in the dataset and can be deployed further.

## 4. RESULTS AND DISCUSSION

Results of Implementation of Convolution Neural Network (CNN) Method on Image Detection Application. The results of the implementation of the CNN method in image detection applications include the results after testing contained in the block diagram.

### Image Scraping & Dataset

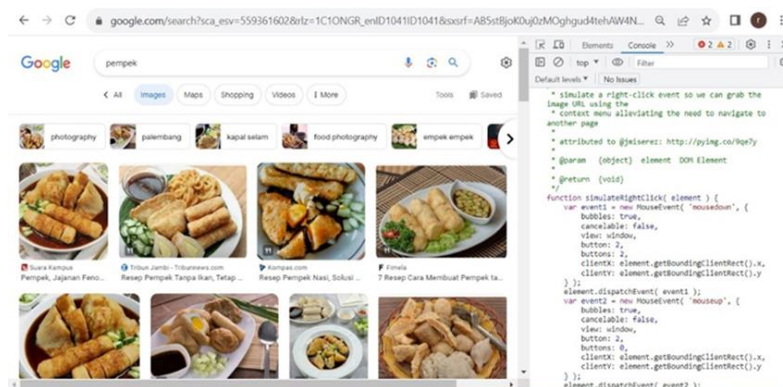


Figure 5. Image Scraping Process on processed pempek fish dishes

At this stage, the image scraping process is carried out which aims to collect images automatically. Image scraping carried out in this study uses Google as a source for

image retrieval. One of them in the picture above does the image scraping process on processed pempek fish dishes taken from Google.

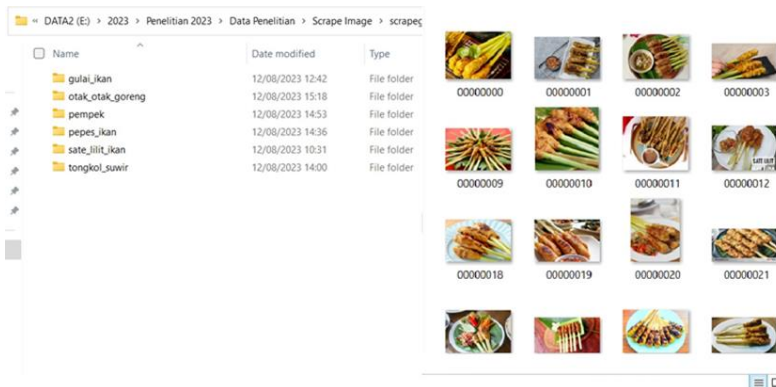


Figure 6. Results of Image Scraping Process

The set of images obtained from the image scraping process is used as a dataset and labelled according to the type of

processed fish cuisine for training at the next stage.

```

filepaths labels
0 dataset/pepek/00000022.jpg pepek
1 dataset/pepek/00000101.jpg pepek
2 dataset/pepek/00000420.jpg pepek
3 dataset/pepek/00000122.jpg pepek
4 dataset/pepek/00000151.jpg pepek
pepek 331
pepes_ikan 274
sate_lilit_ikan 273
gulai_ikan 242
otak_otak_goreng 242
tongkol_suwir 215
Name: labels, dtype: int64
    
```

Figure 7. Process after labelling

**Training, Validation, Testing Data Model & Deploy Model**

At this stage, namely conducting training, validation, and testing. Before the training process is carried out, it is necessary to adjust the dimensions of the dataset, to facilitate the training process and help the training process get the maximum possible

accuracy level. In this study, researchers set all dimensions or dataset sizes to 224x224, based on previous research entitled 'Classification of Brain Tumour Diseases in Mri Images Using CNN Method with Alexnet Architecture', by choosing an image size of 224 x 224 pixels makes the system more thorough in learning image information [29].



Figure 8. Dataset Example Results Dimensions 224 x 224

After the dimensions of the dataset are appropriate, the Training and Validation process of the CNN model can be carried out using the traditional snack image dataset that has been prepared. The training process aims

to optimise the parameters in the CNN model in order to accurately predict the type of processed fish dishes that appear in the image.

```

epochs = 25
history=model.fit(train_gen, epochs=epochs, validation_data=valid_gen)

Epoch 1/25
20/20 [=====] - 31s 883ms/step - loss: 1.7537 - accuracy: 0.4892 - val_loss: 1.0368 - val_accuracy: 0.6203
Epoch 2/25
20/20 [=====] - 13s 640ms/step - loss: 1.0046 - accuracy: 0.6289 - val_loss: 0.8097 - val_accuracy: 0.7278
Epoch 3/25
20/20 [=====] - 14s 711ms/step - loss: 0.7501 - accuracy: 0.7312 - val_loss: 0.6179 - val_accuracy: 0.8165
Epoch 4/25
20/20 [=====] - 13s 621ms/step - loss: 0.5557 - accuracy: 0.7930 - val_loss: 0.5204 - val_accuracy: 0.8165
Epoch 5/25
20/20 [=====] - 13s 648ms/step - loss: 0.4295 - accuracy: 0.8604 - val_loss: 0.5189 - val_accuracy: 0.8165
Epoch 6/25
20/20 [=====] - 13s 657ms/step - loss: 0.3640 - accuracy: 0.8763 - val_loss: 0.5227 - val_accuracy: 0.8165
Epoch 7/25
20/20 [=====] - 14s 670ms/step - loss: 0.2818 - accuracy: 0.9064 - val_loss: 0.3869 - val_accuracy: 0.8671
Epoch 8/25
20/20 [=====] - 13s 662ms/step - loss: 0.2483 - accuracy: 0.9104 - val_loss: 0.4907 - val_accuracy: 0.8165
Epoch 9/25
20/20 [=====] - 13s 650ms/step - loss: 0.2060 - accuracy: 0.9310 - val_loss: 0.4233 - val_accuracy: 0.8544
Epoch 10/25
20/20 [=====] - 14s 693ms/step - loss: 0.1824 - accuracy: 0.9429 - val_loss: 0.4798 - val_accuracy: 0.8418
Epoch 11/25
20/20 [=====] - 13s 639ms/step - loss: 0.1622 - accuracy: 0.9477 - val_loss: 0.5149 - val_accuracy: 0.8544
Epoch 12/25
20/20 [=====] - 14s 688ms/step - loss: 0.1595 - accuracy: 0.9508 - val_loss: 0.4745 - val_accuracy: 0.8354
Epoch 13/25
20/20 [=====] - 13s 652ms/step - loss: 0.1489 - accuracy: 0.9508 - val_loss: 0.5331 - val_accuracy: 0.8101
Epoch 14/25
20/20 [=====] - 13s 652ms/step - loss: 0.1487 - accuracy: 0.9548 - val_loss: 0.5018 - val_accuracy: 0.8291
Epoch 15/25
20/20 [=====] - 13s 665ms/step - loss: 0.1603 - accuracy: 0.9477 - val_loss: 0.5492 - val_accuracy: 0.8354

```

Figure 9. Results of Training and Validation Data at Epoch 25

The test data results from training and validation produce loss, validation loss,

accuracy, and validation accuracy values, which are presented in the graph below.



Figure 10. (a) Training and Validation Loss Graph with Epoch 25, (b) Training and Validation Accuracy Graph with Epoch 25



Figure 11. (a) Training and Validation Graph of Loss with Epoch 50, (b) Training and Validation Graph of Accuracy with Epoch 50



Figure 12. (a) Training and Validation Graph of Loss with Epoch 70, (b) Training and Validation Graph of Accuracy with Epoch 70



Figure 13. (a) Training and Validation Graph of Loss with Epoch 100, (b) Training and Validation Graph of Accuracy with Epoch 100



Figure 14. (a) Training and Validation Graph of Loss with Epoch 120, (b) Training and Validation Graph of Accuracy with Epoch 120



Figure 15. (a) Training and validation loss diagram with epoch 140, (b) Training and validation accuracy diagram with epoch 140

The training and validation loss plot shows the change in loss values in the training and validation data during the training process, where the loss measures the difference between the predicted value and the true value. The "Training and Validation Accuracy" graph shows the increase in model accuracy over time, where higher accuracy means better overall prediction performance of the model. This visualization helps diagnose model performance and determine

necessary adjustments, such as increased training or additional sample data to reduce losses. The results of the tests with different epochs show that the values for training and validation loss and accuracy are affected by the number of epochs used. In addition, the results of the data tests also include the values for precision, recall, and F1 score, which are displayed based on the use of 25, 50, 70, 100, 120, and 140 epochs.

```

Classification Report:
-----
              precision    recall  f1-score   support

   gulai_ikan      0.96      0.96      0.96         23
  otak_otak_goreng  0.64      0.64      0.64         25
      pempek      0.79      0.73      0.76         37
   pepes_ikan      0.86      0.91      0.89         35
  sate_lilit_ikan   0.87      0.90      0.88         29
   tongkol_suwir   0.78      0.78      0.78         18

 accuracy              0.82         167
  macro avg              0.82         167
  weighted avg           0.82         167
    
```

Figure 16. Precision, Recall, and F1 Score results using epoch 140

To prove the performance of the model in predicting the type of snacks correctly, after passing the training,

validation, and testing stages, the model deployment process is carried out as shown below.

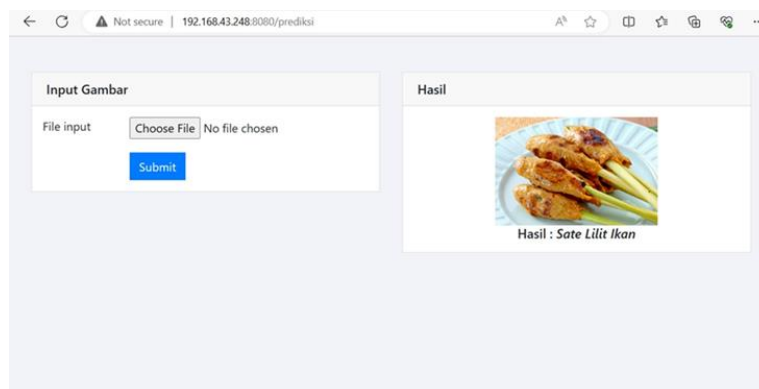


Figure 17. Deployment Model results on processed fish satay dishes

**Database Creation**

#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra	Action
1	ID	int(10)			No	None		AUTO_INCREMENT	Change Drop More
2	Nama	varchar(50)	utf8mb4_general_ci		No	None			Change Drop More
3	Username	varchar(50)	utf8mb4_general_ci		No	None			Change Drop More
4	Email	varchar(100)	utf8mb4_general_ci		No	None			Change Drop More
5	Password	varchar(50)	utf8mb4_general_ci		No	None			Change Drop More

Figure 18. Columns in the user database



Figure 18 shows a table for users whose primary key is in the "ID" column. A primary key is a concept in databases that is used to uniquely identify each row or identity in a table. Basically, a primary key works like a unique identification number for all data in

a table. Creating a database for users is used in the application to log in or register before users can access the application. The user data entered during the login process is stored in the database, as shown below.

	ID	Nama	Username	Email	Password
<input type="checkbox"/> Edit Copy Delete	2	testing	test	test@gmail.com	test1234
<input type="checkbox"/> Edit Copy Delete	3	aabb	aabb	aabb@gmail.com	12345678
<input type="checkbox"/> Edit Copy Delete	4	abab	abab	abab@gmail.com	12345678
<input type="checkbox"/> Edit Copy Delete	5	danzlan	danzlan	danzlan@gmail.com	12345678
<input type="checkbox"/> Edit Copy Delete	6	Noviya Safarah	safnoviya	noviyasafarah@gmail.com	123123

Figure 19. User Table

### API Creation and API Deployment

API creation functions for calling prediction features that use the "GET" and

"POST" methods, while the parameters use files in the form of images

```
@app.route("/predict", methods = ['GET', 'POST'])
def infer_image():
    if (request.content_type.startswith('multipart/form-data')):
        # Catch the image file from a POST request
        if request.method == 'POST':
            # Catch the image file from a POST request
            if 'file' not in request.files:
                return "Please try again. The Image doesn't exist"

            file = request.files.get('file')

            if not file:
                return

            if request.files:
                image = request.files['file']
                img_path = "static/" + file.filename
                image.save(img_path)
                # prediction = predict_label(img_path)
                prediction = predict_label(img_path)
                dicti = {
                    "predict" : prediction
                }

                return jsonify(dicti)
            # Return on a JSON format
            return jsonify(prediction="empty")
```

Figure 20. Deploy API

### Results of Application Development

At this stage produces a system in the form of an application to predict processed fish dishes. This application is connected to the server using the API that has been created.

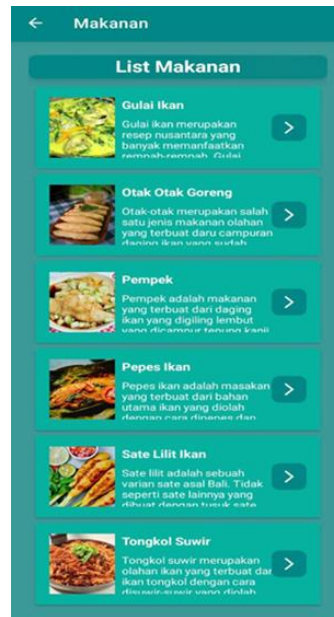


Figure 21. Menu

Accuracy test results with CNN model 120 and 140 obtained from the training results of the system.

Below are the accuracy results for each snack with epoch values of 25, 50, 70, 100,

Table 4.1 Accuracy tests

No.	Jenis Olahan Ikan	Epoch	Akurasi	
			Hasil Training (%)	Perhitungan Teoritis
1	Gulai Ikan	25	92%	93,62%
		50	98%	97,95%
		70	91%	90,71%
		100	87%	86,67%
		120	92%	93,82%
		140	90%	89,95%
2	Otak-Otak Goreng	25	91%	90,90%
		50	92%	91,72%
		70	88%	87,47%
		100	94%	95,32%
		120	89%	88,26%
		140		
3	Pempek	25	96%	95,47%
		50	94%	93,95%
		70	97%	97,43%
		100	96%	95,83%
		120	98%	97,87%
		140	96%	95,47%
4	Pepes ikan	25	94%	94,47%
		50	93%	91,21%
		70	92%	91,82%
		100	92%	91,82%
		120	96%	95,16%
		140	90%	92%
5	Sate Lilit Ikan	25	90%	90%
		50	92%	91,95%
		70	88%	88,28%
		100	93%	92,9%
		120	95%	95,47%
		140	90%	91%
6	Tongkol Suwir	25	89%	89,43%
		50	95%	94,73%
		70	86%	85,43%
		100	90%	89,98%
		120	95%	96%
		140	85%	85,26%

The theoretical calculation formula for the accuracy of each processed fish dish

was derived from the F1 score data of each epoch test for each type of processed fish dish and expressed in the following formula:

$$F1\ Score = 2 \times \frac{Precision \times Recall}{Precision + Recall}$$

$$F1\ Score = 2 \times \frac{Precision \times Recall}{Precision + Recall}$$

$$F1\ Score = 2 \times \frac{0.88 \times 1.00}{0.88 + 1.00}$$

$$F1\ Score = 2 \times \frac{0.88}{1.88}$$

$$F1\ Score = 2 \times 0.4681 = 0.9362$$

### Functionality Test Results

At the stage of the application functionality test results are passed after the application is completed which aims to test the application's capabilities so that it can operate by the objectives and functional requirements that have been set/planned.

At the stage of testing the functionality of the processed fish cooking application, after the application is completed, testing is carried out which aims to test the application's capabilities, so that it can operate by the objectives and functional requirements that have been set/planned. The test results show that all application features, starting from the Splash Screen to features such as Sign Up/Register, LogIn, Search Home, Profile Menu, Camera Menu, Prediction Button, and 'Restaurant' Button, function properly and by the planning and implementation that has been prepared previously. So, it can be concluded that this application has passed the functionality test well, and can be used by user expectations

## 5. CONCLUSION

Based on the research that has been conducted related to the Implementation of the Convolutional Neural Network Method in the application of image detection of processed fish dishes, CNN has been successfully implemented properly through the training, validation, and testing stages,

which shows an accuracy rate between 89% - 97%. This shows the effectiveness of CNN in recognizing and classifying types of processed fish dishes efficiently. Test results on six types of processed fish dishes showed accuracy variations between 63% to 97% at various epochs, with fish pepes achieving the highest accuracy at epoch 120 and fried brain-brain having the lowest accuracy at epoch 50. Dataset variations also affected the classification difficulty. This image detection application has passed the functionality test with a suitable design, ensuring its features run well and can be used by users to detect and classify processed fish dishes effectively.

### Suggestions

Some suggestions needed in the development of future research include further evaluation of the models and methods used, which includes testing using larger and more diverse datasets, as well as considering factors such as parameter tuning, model architecture, and data augmentation techniques to improve model reliability and generalization. Extending the functionality of the app is also an important focus, where in addition to image detection, the app can be extended to provide additional information about the detected processed fish dishes, such as nutritional information or other interesting features that can enhance the added value and user experience. In addition, further research in the field of image detection and

classification of processed fish dishes can be explored further, by trying to address challenges such as performance improvement on difficult-to-classify types of fish dishes and

exploration of more advanced deep learning techniques, such as the use of more complex network architectures or combining with other image processing methods.

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