



School of Computer Science & Electronic Engineering,

Subject:

**Project Proposal**

Submitted as a part of:

**CE902 PROFESSIONAL PRACTISE AND RESEARCH  
METHODOLOGY**

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## **Abstract**

The research will be conducted to detect dog breeds using deep learning algorithms. In this research, the transfer learning models will be used from the domain of deep learning as those are suitable for image analytics and detection of the higher number of classes. The performances of those models will be evaluated using the accuracy and model losses and the overall accuracies will be compared for all models to determine the most effective model for the detection of dog breed.

# TABLE OF CONTENTS

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1	Introduction .....	3
2	Type of Dog Breeds.....	3
3	Aim of Research .....	4
4	Research Questions.....	5
5	Objectives of Research .....	5
6	Problem Statement and Solution .....	6
7	Background Research .....	7
8	Research Components .....	9
8.1	Tool .....	9
8.2	Technology and Algorithms.....	10
8.3	Algorithms.....	11
9	Expected Result and Evaluation .....	11
10	Resources of Research .....	12
11	Project Management .....	12
12	Conclusion .....	14
	References.....	15
	Appendix.....	18
	Research Timeline.....	18

# 1 INTRODUCTION

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Dogs are very good friends and companions of humans. Some dogs are very intelligent and can do their work with due insights. People generally adopt or buy those dogs at the orphanage whom they prefer by their intelligence or beauty. However, at a very young age when they have just been born, it may be hard to identify the type of breeds or the type of dogs [1]. For example, it is hard to differentiate the dog breed namely Labrador, Retriever and Golden retriever at first look when they are orphans. Breeding is done to modify the genome structure and thereby changing the nature of the dogs. So, breeding is an important parameter for dogs to make them different from others. While buying those dogs, the identification of breed is very important and the choice of purchase of different kinds of dogs depends upon the type of breeding [2].

In this project, the detection will be done on the dog breed types based on the features of the dogs and emphasizing the characteristics aspects using deep learning.

## 2 TYPE OF DOG BREEDS

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Different types of dog breeds are there in the world. Based on the nature of work and appearance, they are divided into many groups. Some of the well-known and important Dog breed groups are discussed below:

### **Sporting Group**

These types of dogs are reproduced by breeding to show more intelligence at the time of action or sports. Some of the well-known dog breeds in this group are spaniels, pointers, retrievers, and setters. They can be used anywhere such as in sports to catch the ball

or at the time of the action to find the bombs. To find the bomb, retrievers are mostly used because of their intelligence.

### **Hound Group**

The dogs in this type of breed are generally working upon the warm-blooded quarry and are heavy in nature. The power of smell is higher in this group and thus, their dogs are used in the criminal division of government. They have the power to find the bomb, wanted criminals and they can run very fast. They are also highly qualified in spending their livings in the worst condition of weather.

### **Toy Group**

The dogs in this group are known for their cuteness and behaviours. They are not used for any kind of security purposes but stay at home with the members of the house. They also have the intelligence and they can do the regular work as house members by catching the work process from the house members. They are comparatively small in shape.

### **Working Group**

The dogs in this group are exclusively used for guarding purposes. Some of the well-known breeds in this group are Boxer, Bernese Mountain Dog, Great Dane, Doberman Pinscher, Mastiff, Leonberger and Dogo Argentino. They are used to guard the properties of the household as well as for secured and protected places. They have a higher power in smelling and have the lengthier eye-sight.

## **3 AIM OF RESEARCH**

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The research aims to apply a deep learning algorithm to identify the dog breed from the image of the dog. In this research, the deep learning classifiers will be used along with the image

processing through which the analytics on the image will be done and the classification of dog breed will be performed.

## 4 RESEARCH QUESTIONS

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The research questions have been prepared for the proper conduction of the research and to address those after the execution of the research. The research question has been framed to fulfil the aim of the research. The research questions are as follows:

RQ-1. Can the dog be detected based on the breed types with effectiveness?

RQ-2. Is there any challenge in this research? If so, how those can be overcome?

RQ-3. Which classifier in deep learning can detect dog breed with the highest accuracy?

## 5 OBJECTIVES OF RESEARCH

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The objectives of the research have been taken to fulfil the research aim and to address the research questions satisfactorily. Hence the objectives of the research are discussed below:

**Research Objective-1.** Study the application of deep learning algorithms and frameworks emphasizing the detection of Dog Breed and other fields from the previous papers [3]

***Deliverables:*** The list of research papers along with the reviews concerning the application aspects and the effectiveness of models

***Timeline:*** 3 weeks

**Research Objective-2.** To identify the data where the image records will be there for different dog breeds [4]

***Deliverables:*** Data selection and the details of the data attributes like image details, image resolution, count etc.

*Timeline:* 1 week

**Research Objective-3.** To select the algorithms and framework for the detection of dog breeds for the image database

*Deliverables:* List of applicable algorithms which have been selected based on the ideas taken from previous approaches

*Timeline:* 1 week

**Research Objective-4.** To pre-process the data using image augmentation & prepare the data for detection using deep learning [3]

*Deliverables:* Data Pre-processing and Preparation

*Timeline:* 1 week

**Research Objective-5.** To train the algorithms using the preprocessed data and test those and record the effectiveness through accuracy and loss of the models and select the most effective models from the selected algorithms [5]

*Deliverables:* Test report of the algorithms and the comparison result

*Timeline:* 4 weeks

**Research Objective-6.** To compare the effectiveness of detection of dog breeds with the previous approach and identify the improvement & achievement

*Deliverables:* Comparison of results for the most effective model with the existing approaches

*Timeline:* 1 week

## 6 PROBLEM STATEMENT AND SOLUTION

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The initial problem for this research is the resolution of images and the number of classes. As there are a lot of dog breeds and several different images will be stored in the database, this may raise the detection issue [6]. This is mainly because most of the deep learning frameworks

may not handle image databases with a higher number of classes. In that case, the classifier will raise the misclassification error which will turn the accuracy of the detection lower [7].

To overcome this situation, it has been planned to tune the algorithm and prepare it compatible to manage a higher number of classes by adding more layers and units into it.

## **7 BACKGROUND RESEARCH**

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Varshney et al. (2021) have proposed the deep learning model to detect the type of breeds of dogs. In this research, they have selected the dog breed database that contains different types of images related to multiple types of dog breeds. To detect the type of dog, they have applied transfer learning through deep learning algorithms. In this context, they have primarily augmented the data and prepared it for classification. After data augmentation has been done, they have applied the classifiers of deep learning to classify and detect dog breeds.

Borwarnginn et al. (2019) have prepared the model to detect the types of dog breeds. In this research, they have selected the TensorFlow dog breed database that contains 120 types of dog breeds with several images by class. They have faced the primary challenge in that database as the number of classes is very high. This is because, if the number of classes is higher in a data, the problem may occur to get the classification accuracy that leads to the misclassification. To overcome the problem, they have applied Convolutional Neural Network along with the application of Local Binary Patterns and a Histogram of Oriented Gradient for the detection of dog breeds.

Sinnott et al. (2018) have designed a mobile application through which the images of the dog can be taken to detect the breed types. In this research, they have selected the TensorFlow dog breed database that contains 120 types of dog breeds with several images by class. However, they have utilised the database in two ways. To detect the dog breed they have applied



Convolutional Neural Network on the 50m classes of the database and next they have applied Convolutional Neural Network on the entire 120 classes of the database. In the first case, they have achieved good results whereas, for the latter one, the performance of the Convolutional Neural Network was low.

Shah et al. (2020) have applied Convolutional Neural Network for the detection of dog breeds. In this research, they have emphasized the detection of facial expressions to identify the breed types of dogs. In this experiment, they have selected the TensorFlow dog breed database that contains 120 types of dog breeds. To detect the dog breeds, they have prepared the Convolutional Neural Network model to make it compatible to handle a higher number of classes. Later, by applying the Convolutional Neural Network, they have successfully classified the dog breeds.

Agrawal et al. (2021) have proposed the deep learning model to detect the breeds of sheep. They have selected the images of four different breeds of sheep and applied a deep learning algorithm to classify and detect the breed types. In this experiment, they have applied the transfer learning algorithms and frameworks such as ResNet50, VGG16, VGG19, InceptionV3 and Xception. To fulfil the aim of the research, they have augmented the sheep image data and applied the transfer learning model in it. They have observed that ResNet50 and VGG19 are performing almost similar in the detection of sheep breeds. So, finally, they have created the ensemble or hybrid deep learning model using ResNet50 and VGG19 and proposed the final model for the detection of sheep breeds.

In paper [8], they have proposed the model to detect the breeds of dogs using a Convolutional Neural Network. They have selected the dog breed database and identified that different types of dog breed images have been recorded there. Now, to classify the dog breed types, they have

applied image augmentation and pre-processed the images to make them compatible with the algorithms. Next, they have applied deep learning algorithms to classify the dog breed types.

In paper [9] they have applied transfer learning on the convolutional neural network to detect the dog breed. Initially, they have selected the TensorFlow dog breed database that contains 120 types of dog breeds. Next, they have reviewed the previous approaches where the researchers have applied the deep learning models to detect dog breeds and for other classification operations. In the context of dog breed detection from the previous approaches, they have found that very few algorithms and approaches have performed well with good accuracy for the detection of dog breeds. By observing the phenomena, they have tried with the traditional transfer learning models such as GoogleNet. They have trained and evaluated the model but they did not get a satisfactory outcome for the dog breed detection on 120 classes. To overcome the problem, they have proposed their model namely BreedNet and DogNet through which they have detected the dog breed types.

## **8 RESEARCH COMPONENTS**

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The research will contain certain components through which it will be conducted for the detection of dog breeds. The components are like the tools and technology along with the algorithms that will help to detect the breed of dogs. The components are discussed below.

### **8.1 TOOL**

Python 3 will be selected as the programming language through which the detection of dog breed will be done using deep learning algorithms. The reasons behind the choice of Python 3 are as follows:

1. Python 3 has a wide range of deep learning algorithms

2. The implementation and application of transfer learning are easy in python 3.
3. Python 3 is a platform-independent programming language.
4. Python 3 can produce the interactive output of the coding if the code will be written in Jupyter Notebook or Google Colaboratory.
5. Python 3 is a dynamically typed programming language.
6. Python 3 is an open-source programming language.

## **8.2 TECHNOLOGY AND ALGORITHMS**

In this research, deep learning algorithms will be used. In this context, as the number of classes of dog breed will be higher (as found in the literature review), transfer learning will be used for dog breed detection. Transfer learning is the type of algorithm that belongs to deep learning where a model will be developed for a task by designing the layers and units and will be reused for further works [3]. It is a kind of pre-trained model where the model file will be used for training and testing on the new data and classifying it. It allows the optimization process that facilitates improved performance when modelling further tasks. The process of designing or developing a model on a dataset and reusing it for the next task is called inductive transfer [10]. In this context, the approach for the development and application aspects are discussed below:

- **Selection of Primary Operation:** The developer of the model should select the predictive modelling type in relation to the underlying database. The model can be built up by providing the input and through which the output can be achieved. In this scenario, the output will be the classification result [11].
- **Developing the Source Model:** Next, the developer will design the model by adding the necessary layers and units so that it will work better with an image database.
- **Reusing Model:** One of the main objectives is to reuse the transfer learning model. In this context, the model should be trained with the data and evaluated and the result will

be obtained. After getting the satisfactory result, the model will be stored in the device or cloud so that it can be loaded and reused by others or for other operations [12].

- **Model Tuning:** Model tuning is one of the issues through which the performance can be enhanced. By modifying the model parameters, tuning can be done so that a better classification result can be obtained [13].

### **8.3 ALGORITHMS**

In this research, the following algorithms are planned to be used:

- Convolutional Neural Network
- VGG19
- ResNet151V2
- DenseNet201

## **9 EXPECTED RESULT AND EVALUATION**

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The result will produce the artefact through which the detection of dog breed will be done. In this context, the algorithms will be prepared by parameter tuning and by adding necessary layers so that they can manage a large database with a higher number of classes [10]. By applying those classifiers, the detection results will be obtained by the accuracy and model loss. The expected result of this research will be the detection of the dog by the type of breeds by image processing and applying classifiers [2]. The detection of dog breed will be done by different classifiers and the result for all those algorithms will be found.

The evaluation will be done in this research after getting the performances of all classifiers. The performances such as the accuracy of detection and the loss of the model will be compared to get the most effective model for dog breed detection. Finally, the most effective model will

be chosen that have produced the highest accuracy in training and testing phases and produced low mode loss [11]. The performance of the most effective model will be compared with the existing models and the achievement and improvement will be found.

## **10 RESOURCES OF RESEARCH**

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The research will require the following resources:

1. Database: This will be required as the algorithms will be applied to it to detect the breeds of dogs
2. Algorithms: Deep Learning algorithms will be required as those will be applied to the database for the purposes of classification and detection of dog breeds
3. Previous Research: This resource will provide ideas regarding the process of applying deep learning algorithms and the detection of dog breeds.
4. Platform: Platform is one of the essential resources for the detection of dog breeds and the coding will be done there. In this context, Graphical Processing Unit will be used for the detection of dog breeds.

## **11 PROJECT MANAGEMENT**

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The plan for the research including all activities is shown below in the Gantt chart:

Sl. No.	Task Name / Objective	Duration	Start date	End Date	Tasks - Days->	Literature Review		Data Selection		Selection of Algorithms		Data Preparation		Train and Test the algorithms with selected database			Preparing Documentation and Presentation	
						21	14	5	7	3	7	7	7	7	2	2	21	7
1	Literature Review	40	02/04/2022	17/04/2022														
1.1	Review of Previous literatures	21	02/04/2022	23/04/2022														
1.2	Study the approaches	14	23/04/2022	07/05/2022														
1.3	Identify the use of deep/transfer learning algorithms	5	07/05/2022	12/05/2022														
2	Data Selection	10	13/05/2022	23/05/2022														
2.1	Search for data in public source	7	13/05/2022	20/05/2022														
2.2	Study the features of the data	3	20/05/2022	23/05/2022														
3	Selection of Algorithms	21	24/05/2022	14/06/2022														
3.1	Selection of Deep Learning Algorithms	7	24/05/2022	31/05/2022														
3.2	Tune the parameters	7	31/05/2022	07/06/2022														
3.3	Prepare the algorithms to detect dog breeds	7	07/06/2022	14/06/2022														
4	Data Preparation	11	15/06/2022	26/06/2022														
4.1	Image Augmentation	7	15/06/2022	22/06/2022														
4.2	Normalization	2	22/06/2022	24/06/2022														
4.3	Prepare Final Data	2	24/06/2022	26/06/2022														
5	Train and Test the algorithms with selected database	31	27/06/2022	28/07/2022														
5.1	Train the models and test those using prepared data	21	27/06/2022	18/07/2022														
5.2	Compare performance and select best model	7	18/07/2022	25/07/2022														
5.3	Compare the performance with the existing research	3	25/07/2022	28/07/2022														
6	Preparing Documentation and Presentation	21	28/07/2022	18/08/2022														

## **12 CONCLUSION**

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The research will be conducted based on the ideas that will be gathered from the previous researchers concerning the concept of the deep learning application. As seen in the brief literature review, most researchers have used transfer learning to detect dog breeds, so, in the research transfer learning will be used for the classification and detection of dog breeds.

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# APPENDIX

## RESEARCH TIMELINE

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1	Literature Review	40	02/04/2022	17/04/2022
1.1	Review of Previous literatures	21	02/04/2022	23/04/2022
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1.3	Identify the use of deep/transfer learning algorithms	5	07/05/2022	12/05/2022
2	Data Selection	10	13/05/2022	23/05/2022
2.1	Search for data in public source	7	13/05/2022	20/05/2022
2.2	Study the features of the data	3	20/05/2022	23/05/2022
3	Selection of Algorithms	21	24/05/2022	14/06/2022
3.1	Selection of Deep Learning Algorithms	7	24/05/2022	31/05/2022
3.2	Tune the parameters	7	31/05/2022	07/06/2022
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6	Preparing Documentation and Presentation	21	28/07/2022	18/08/2022