



AI & ML Based Pet Feeding System using Image Processing

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ABSTRACT— The AI & ML Based Pet Feeding System is a smart solution designed to identify different types of pets using image processing and deep learning techniques, specifically Convolutional Neural Networks (CNN). The system is trained on a dataset consisting of 74 different pet types using thousands of labelled images. Once trained, the model can accurately classify pets from new images uploaded by users. The application includes several modules such as dataset upload, pre-processing, train-test splitting, model training, and pet classification. After identifying the pet, the system provides feeding recommendations including suitable foods and foods to avoid, helping pet owners maintain their pet's health. The CNN model achieves high prediction accuracy, with overall performance reaching up to 93%. Graphical outputs like training accuracy, loss curves, and precision-recall for each class make the model performance transparent. This system offers an innovative and practical tool for pet identification and health-conscious feeding, making it useful for pet lovers, caretakers, and veterinary applications.



INTRODUCTION

Today, people tend to be busier and because of their existence, they tend to overlook some of the obligations that can be a major reason for their problems. One of those commitments is keeping a puppy at home is to keep Most people want their pets for their attractive looks, loyalty and playful personality. Having a puppy is a joy for the family and for the employer, so having a puppy is a responsibility that is not wasted. Giving A big problem in society is how busy people are. This is one of the main reasons why puppy owners act irresponsibly when it comes to pet care. Your pet seems to be at the bottom of your priority list. An important element in puppy care is feeding. This is where this challenge comes into play, where feeders based primarily on digital image processing are activated with pet detection and recognition. Our mission motivation is to provide an easier and more efficient way to feed pets, even when pet owners are away from home and cannot operate remotely. Specifically, develop a design that automatically recognizes a specific pet, makes the recognized pet healthy with the most recent saved pet profile, and provides that person with the correct amount and type of food. The purpose is that. The important point is that feeders can help different kinds of pets.

I. PROBLEM DEFINITION

In today's fast-paced lifestyle, many pet owners struggle to maintain a consistent and timely feeding schedule for their pets. Irregular feeding can lead to health issues such as obesity, malnutrition, and behavioral problems. Traditional automatic pet feeders operate on fixed timers and lack the intelligence to adapt to the pet's actual presence, behavior, or feeding needs.

Moreover, these systems cannot differentiate between pets, detect whether food has already been consumed, or identify unusual feeding patterns. This can result in overfeeding, underfeeding, or food wastage. In multi-pet households, the problem becomes more complex as existing systems cannot ensure that the right pet is being fed.

To address these limitations, there is a need for an intelligent system that integrates **Artificial Intelligence (AI)** and **Machine Learning (ML)** with **image processing** techniques. Such a system should be capable of detecting the presence of a pet, recognizing its identity, analyzing feeding behavior, and making real-time decisions about food dispensing. The goal is to ensure accurate, efficient, and personalized feeding while reducing human intervention and improving pet health and well-being.

1.2 PROJECT FEATURES

The proposed system provides a simple and efficient interface for monitoring and managing pet feeding using advanced image processing techniques. It captures images of the pet feeding area through a camera and performs preprocessing by converting the captured images into suitable formats and normalizing them to improve quality and consistency. The dataset used for training is automatically organized, shuffled, and divided into training and testing sets, reducing manual effort and ensuring reliable model performance.

A deep learning-based model, such as a Convolutional Neural Network (CNN), is used to detect the presence of pets and analyze their feeding behavior. The system can identify whether a pet is present near the feeding area and determine if food has been consumed or needs to be dispensed. It supports automated decision-making by triggering the food dispensing mechanism only when required, preventing overfeeding and food wastage. The system achieves high accuracy in detecting pets and their activities, making it reliable for real-world applications. Additionally, it allows users to monitor feeding status and input new images for real-time detection and analysis. This intelligent approach ensures timely, accurate, and efficient feeding while minimizing human intervention and improving overall pet care.

Related Work

II. METHODOLOGY

The proposed system for an AI & ML-based pet feeding system follows a structured methodology consisting of multiple stages, including data acquisition, preprocessing, model training, and intelligent decision-making using image processing techniques.



1. Data Collection

The data used in this project is collected using cameras installed near the pet feeding area. These datasets consist of images of pets during feeding and non-feeding conditions. The dataset includes labeled images indicating the presence or absence of a pet and feeding behavior. A sufficient number of images are collected to train and test the model effectively.

2. Data Preprocessing

The collected image data is preprocessed to improve quality and consistency. The steps include:

- Image resizing to a uniform dimension
 - Noise removal and image enhancement
 - Dataset shuffling to avoid bias
 - Normalization of pixel values
- After preprocessing, the dataset is split into:
- Training Data (80%)
 - Testing Data (20%)

3. Feature Extraction

Feature extraction is performed automatically using deep learning models. Instead of manual feature engineering, Convolutional Neural Networks (CNNs) extract important features such as shape, texture, and pet posture from images, improving detection accuracy in real-time scenarios.

4. Model Training

Deep learning-based models are used for training:

- Proposed Model – CNN-based Pet Detection Model
- Extension Model – CNN with Transfer Learning (e.g., VGG16/ResNet50)

These models are trained on the processed dataset to recognize pets and analyze their feeding behavior accurately.

5. Model Evaluation

The performance of the trained models is evaluated using the following metrics:

- Accuracy
- Precision
- Recall
- F1-Score

Additionally, training and validation performance is analyzed using:

- Accuracy Graph
- Loss Graph

6. Result Comparison

The performance of both models is compared:

- Proposed Model achieves high accuracy in detecting pet presence
- Extension Model achieves improved accuracy and lower loss

7. Prediction

The trained model is used for real-time pet feeding decisions:

- Input image is captured from the camera
- Model processes the image
- Pet presence is detected
- Feeding action is triggered if required

To improve efficiency, the system avoids repeated feeding if the pet has already been served.



8. Output Generation

Finally, the system provides:

Prediction results , Graphical analysis , Performance comparison . This helps ensure accurate, timely, and intelligent pet feeding while reducing manual intervention.

III. PROPOSED SYSTEM

IV. Proposed System

The The proposed AI and ML-based pet feeding system incorporates image processing technology to monitor and analyse the pet's eating behaviour. It uses cameras and machine learning algorithms to identify the pet, track its food consumption, and adjust the portions accordingly. The system can also learn the pet's preferences, hunger patterns, and health requirements, providing personalized feeding schedules and portions. This smart feeding system can be controlled remotely through a mobile app and is capable of notifying the pet owner about the pet's eating habits or when the food supply is running low. Additionally, the system is capable of handling multiple pets, maintaining feeding records, and adapting to different environmental conditions, making it a reliable, efficient, and smart solution for modern pet care.

V. IMPLEMENTATION DETAILS

The implementation phase of the AI & ML-based pet feeding system involves executing the planned methodology for detecting pets and managing feeding using image processing techniques. It includes capturing image data through a camera, preprocessing the images, and converting them into a suitable format for deep learning models. The system is implemented using Python in a Jupyter Notebook environment, where different modules such as image acquisition, data preprocessing, feature extraction, model training, and evaluation are integrated and coordinated effectively.

4.1 ALGORITHMS USED

4.1.1 CNN-Based Models for Feature Extraction

Convolutional Neural Networks (CNNs) are widely used in this project for extracting spatial features from pet images. Models such as ResNet50 and VGG16 are employed to analyze captured images and identify important patterns related to pet detection and feeding behavior. These CNN models automatically learn features such as edges, shapes, textures, and pet posture, which are essential for distinguishing pets from the background. The extracted features are then used for accurate detection and decision-making in the feeding system.

4.1.2 CNN-Based Detection for Pet Recognition

CNN-based detection algorithms are used in this project for identifying the presence of pets in the captured images. The input images are processed using a CNN backbone like ResNet50 or VGG16 to extract meaningful features. These features help in classifying whether a pet is present near the feeding area or not. Based on this detection, the system decides whether to trigger the food dispensing mechanism, ensuring intelligent and need-based feeding.

4.1.3 ResNet50 for Deep Feature Extraction

In this project, ResNet50 is used as a deep convolutional neural network for extracting high-level features from pet images. ResNet50 uses residual learning, which helps in training very deep networks without the vanishing gradient problem. It improves the system's ability to detect pets accurately even in complex backgrounds or varying lighting conditions, thereby enhancing overall performance.

4.1.4 VGG16 for Image Classification

VGG16 is used as an alternative backbone model for image classification in the system. It consists of multiple convolutional layers that capture fine-grained image details. In this project, VGG16 helps in identifying pet presence and analyzing feeding-related patterns. Although it is computationally heavier, it provides reliable and accurate feature extraction, supporting better decision-making in the feeding process.



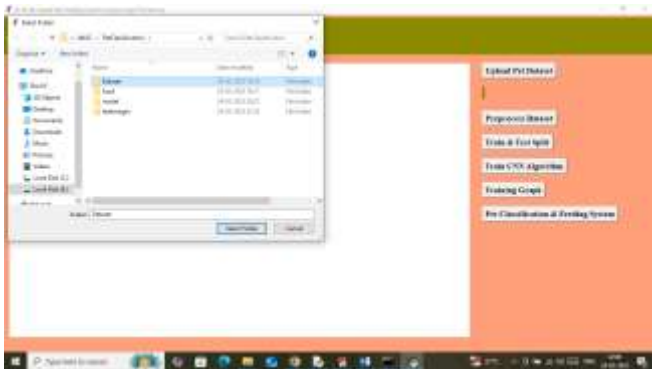
4.1.5 Support Vector Machine (SVM)

In this project, Support Vector Machine (SVM) is used as a baseline classifier for detecting pet presence based on extracted features. It works by utilizing features obtained from CNN models to classify images as “pet present” or “pet absent.” While SVM provides a simple and effective machine learning approach, its accuracy is comparatively lower than deep learning models. The main limitation of SVM is its inability to capture complex image patterns and real-time variations, making CNN-based models more suitable for intelligent pet feeding systems.

V. EXPERIMENTAL RESULTS AND DISCUSSION

The experimental results of the AI & ML-based pet feeding system demonstrate the effectiveness of using image processing and deep learning techniques for intelligent and automated pet feeding. The system was trained and tested on a dataset of pet images captured under different conditions, including varying lighting, backgrounds, and pet positions.

Pet dataset selection:



Pet dataset selection and processing system interface

Fig. 1. Training Graph of CNN Model



Fig. 2. Final Output Page

Shows training and validation accuracy and loss across epochs, indicating model performance improvement.



Final Pet Detection Output Image

VI. CONCLUSION

In conclusion, The AI & ML-based pet feeding system using image processing provides an intelligent and efficient solution for automated pet care. By integrating deep learning models such as Convolutional Neural Networks (CNNs), the system is capable of accurately detecting the presence of pets and analyzing their feeding behavior in real time. Unlike traditional timer-based feeders, this system makes smart decisions based on actual conditions, ensuring that pets are fed only when required. The implementation demonstrates high accuracy, reduced food wastage, and minimal human intervention. The use of advanced models like ResNet50 and VGG16 improves feature extraction and enhances detection performance even in complex environments. Overall, the system proves to be reliable, cost-effective, and suitable for real-world applications, contributing to better pet health and convenience for pet owners.

VII. FUTURE SCOPE

The proposed AI & ML-based pet feeding system can be further enhanced by integrating advanced technologies to improve its efficiency and functionality. In the future, the system can be connected with IoT platforms to enable remote monitoring and control through mobile applications, allowing pet owners to manage feeding schedules from anywhere. It can also be upgraded to support multi-pet recognition, ensuring personalized feeding for each pet based on their identity and dietary needs. The incorporation of night vision or infrared cameras can improve performance in low-light conditions, making the system more reliable at all times. Additionally, combining image processing with voice recognition can help in more accurate pet identification. Future improvements may also include the use of more advanced deep learning models for faster and more accurate detection.

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