A Minor Project Report on

Machine Learning and Image Processing Methods for Cetacean Photo Identification: A Systematic Review

Submitted to

Jawaharlal Nehru Technological University, Hyderabad in partial fulfilment of the requirements for the award of the degree BACHELOR OF TECHNOLOGY

in

ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

by

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ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

GURU NANAK INSTITUTE OF TECHNOLOGY
(Affiliated to JNTUH-Hyderabad)
Ranga Reddy District-501506

2024-25

GURU NANAK INSTITUTE OF TECHNOLOGY
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Ranga Reddy District-501506

CERTIFICATE

This is to certify that the project entitled "**Machine Learning and Image Processing Methods for Cetacean Photo Identification: A Systematic Review**" is being presented with a report by **P Oohasri lasya(21831A7253), R Dhanesh (21831A7256), Adirala Sumanth (22835A7201)** in partial fulfillment for the award of **Degree of Bachelor of Technology in Artificial Intelligence & Data Science, to Jawaharlal Nehru Technological University, Hyderabad**.

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PROJECT COMPLETION CERTIFICATE

This is to certify that the following students of final year B. Tech, Department of ARTIFICIAL INTELLIGENCE AND DATA SCIENCE - Guru Nanak Institute of Technology (GNIT) have completed their training and project at GNIT successfully.

STUDENT NAME:	Roll No:
1. P. OOHA SRI LASYA	21831A7253
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The training was conducted on PYTHON Technology for the completion of the project titled **Machine Learning and Image Processing Methods for Cetacean Photo Identification** in 2024-2025. The project has been completed in all aspects.

Signature

GURU NANAK INSTITUTE OF TECHNOLOGY

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VISION OF GNIT

To be a world-class educational and research institution in the service of humanity by promoting high quality Engineering and Management Education.

MISSION OF GNIT

- Imbibe soft skills and technical skills.
- Develop the faculty to reach international standards.
- Maintain high academic standards and teaching quality that promotes the typical thinking and independent judgment.
- Promote research, innovation and Product development by collaboration with reputed foreign universities.
- Offer collaborative industry programs in emerging areas and spirit of enterprise.

GURU NANAK INSTITUTE OF TECHNOLOGY

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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

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To be a premier Department of Emerging Technologies, Known globally for value based education, Research & Innovation through academic excellence to serve the needs of industry and society.

MISSION

- Develop a strong foundation on fundamentals of Artificial Intelligence & Data Science through Outcome based Teaching Learning process.
- Establish state of art & Centre of Excellence facilities in Emerging technologies for Design and development of Innovative Products.
- Involve the students in Group activities, including those of professional bodies to develop leadership, entrepreneurship and good communication skills.

GURU NANAK INSTITUTE OF TECHNOLOGY

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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

PROGRAM EDUCATIONAL OBJECTIVES (PEO'S)

PEO 1: Ability to apply the knowledge of Emerging Technologies to solve industry and societal problems.

PEO 2: Ability to choose or develop an efficient tool for Emerging Technologies.

PEO 3 : Have an ability to adapt to a rapidly changing environment by having learned and applied cutting-edge skills in emerging technologies.

PEO 4: Build a strong foundation in the field of artificial intelligence, cyber security, machine learning, and data science to contribute significantly in the area of innovations and research.

PEO 5: Have strong work ethics, professional attitude, team spirit, leadership, and enterprising skills to serve industry and society.

PROGRAM OUTCOMES (PO'S)

PO-1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO-2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO-3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, and the cultural, societal, and environmental considerations.

PO-4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO-5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO-6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO-7: Environment and sustainability: Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO-8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO-9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO-10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO-11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSO'S)

PSO-1: Professional Skills: The ability to understand the principles and working of computer systems. Students can assess the hardware and software aspects of computer systems.

PSO-2: Problem Solving Skills: The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.

PSO-3: Successful Career and Entrepreneurship: The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies.

DECLARATION

We hereby declare that the major project report entitled "**Machine Learning and Image Processing Methods for Cetacean Photo Identification: A Systematic Review**" is being presented with a report by **P Oohasri lasya , R dhanesh ,Adirala Sumanth** bearing the roll no's **21831A7253, 21831A7256, 22835A7201** towards the fulfilment of the requirement for the award of the **Degree of Bachelor of Technology in Artificial Intelligence & Data Science, from Jawaharlal Nehru Technological University, Hyderabad,** is the result of the work carried out under the guidance **Ms.D.SWETHA** , Assistant Professor – Department of Artificial Intelligence & Data Science **Guru Nanak Institute of Technology, Hyderabad.**

We further declare that this project report has not been previously submitted either in part or full for the award of any degree or diploma by any organization or university.

21831A7253	**P .OOHA SRI LASYA**
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ACKNOWLEDGEMENT

"Task successful" makes everyone happy. But the happiness will be gold without glitter if we didn't state the persons who have supported us to make it a success.

We would like to express our sincere thanks and gratitude to our Principal, **Dr. KODUGANTI VEKATA RAO** and **Dr. SHEETAL KUNDRA**, Professor & Head - Department of Artificial Intelligence & Data Science, Guru Nanak Institute of Technology for having guided me in developing the requisite capabilities for taking up this project.

We thank Project Coordinator **Mr. G.S.NILAVARASAN**, Assistant Professor **AIDS, GNIT** for providing seamless support and right suggestions that are given in the development of the project.

We specially thank our internal guide **Ms. D.SWETHA**, Assistant Professor – Department of Artificial Intelligence & Data Science for his constant guidance in every stage of the project. We would also like to thank all our lecturers for helping me in every possible way whenever the need arose.

On a more personal note, we thank our beloved parents and friends for their moral support during the course of our project.

ABSTRACT:

Photo identification is an essential method to identify cetaceans, by using natural marks over their body, and allows experts to acquire straightforward information on these animals. The importance of cetaceans lies in the fact that they play a crucial role in maintaining the healthiness of marine ecosystems, however they are exposed to several anthropogenic stressors, under which they could collapse with extreme consequences on the marine ecosystem functioning. Hence, obtaining new knowledge on their status is extremely urgent for the marine biodiversity conservation. The smart use of technology to automate the individual recognition can speed up the photo identification process, opening the door to large-scale studies that are manually unfeasible. We performed a systematic review on systems based on machine learning and statistical methods for cetacean photo identification, following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement. This review highlights that interest has been increasing in recent years and several intelligent systems have been presented. However, there are still some open questions, and further efforts to develop more effective automated systems for cetacean photo identification are recommended.

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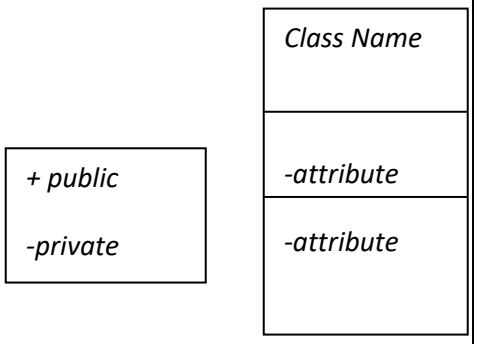
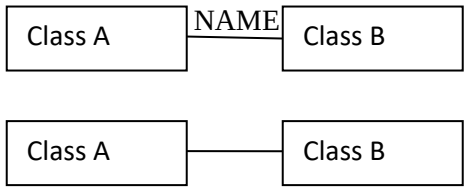
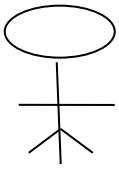
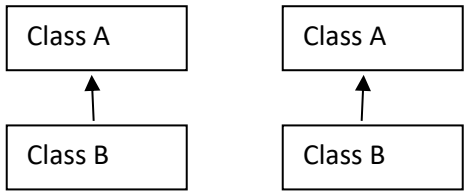
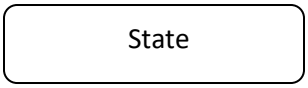
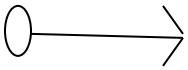
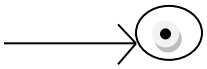
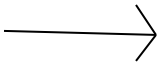
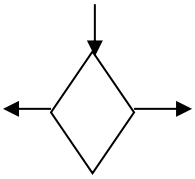
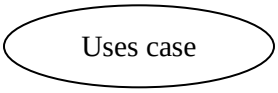
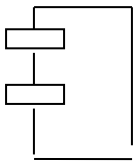
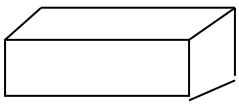
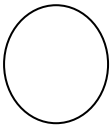
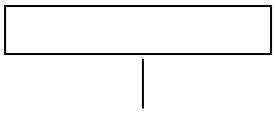
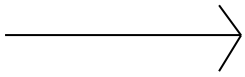
LIST OF FIGURES

LIST OF SYMBOLS

S.NO	NOTATION NAME	NOTATION	DESCRIPTION
1.	Class		Represents a collection of similar entities grouped together.
2.	Association		Associations represents static relationships between classes. Roles represents the way the two classes see each other.
3.	Actor		It aggregates several classes into a single classes.
4.	Aggregation		Interaction between the system and external environment

5.	Relation (uses)	uses	Used for additional process communication.
6.	Relation (extends)		Extends relationship is used when one use case is similar to another use case but does a bit more.
7.	Communication		Communication between various use cases.
8.	State		State of the processes.
9.	Initial State		Initial state of the object
10.	Final state		Final state of the object
11.	Control flow		Represents various control flow between the states.
12.	Decision box		Represents decision making process from a constraint
13.	Use case		Interact ion between the system and external environment.

14.	Component		Represents physical modules which are a collection of components.
15.	Node		Represents physical modules which are a collection of components.
16.	Data Process/State		A circle in DFD represents a state or process which has been triggered due to some event or action.
17.	External entity		Represents external entities such as keyboard, sensors, etc.
18.	Transition		Represents communication that occurs between processes.
19.	Object Lifeline		Represents the vertical dimensions that the object communications.
20.	Message	Message 	Represents the message exchanged.

CHAPTER-1

INTRODUCTION

1.1 INTRODUCTION:

Photo Identification (photo ID) is a noninvasive technique devoted to the identification of individual animals using photos, and it is based on the hypothesis that each specimen has unique features useful for recognition. One of the main fields where photo identification has been applied is related to marine fauna, particularly cetaceans. The sea animals play a key role in marine biodiversity conservation, because they maintain the stability and healthiness of marine ecosystems due to their control roles as top predators or consumers in food webs. The information obtained with photo identification studies is useful for acquiring new knowledge on their abundance estimation, social dynamics, pattern migration and site fidelity of the species under study. However, manual photo identification is time-consuming and impractical in case of large datasets.

Computer-aided systems have been developed to support researchers during photo identification studies, to reduce the user effort and the time required to perform the study. Data used for cetacean photo ID studies are images containing well-exposed dorsal or caudal fin (depending on the species to be photo-identified) of the animal. However, fin images acquisition during a marine survey is not a trivial task, due to the unavailability of a static subject to be pictured, to the dynamic nature of the background, and to lighting effects. In fact, subjects in the foreground of the images are cetaceans in continuous movement, so the images may contain the fin of the animal but also other parts of the body, not useful for its photo identification, and the distance of the animal can vary a lot. Moreover, often in the photos two or more dolphins are captured while swimming together. In addition, the images may also contain other moving objects or parts thereof, such as vessels, other animals (i.e., birds or turtles), and fixed structures during sightings in ports or near the coast. In marine images there are also trails, foams, splashes of water, clouds which can be qualified as background. In case of manual photo ID, experts can effectively manage these images, selecting

useful information to solve the task. When a large number of images needs to be analyzed or when a huge number of already known and catalogued individuals is available, the manual task of going through photographs becomes tedious and human resource demanding. Hence, using advanced techniques can support users and accelerate the process of individual photo identification. The automated processing of these images involves several steps: an object detection phase, a cropping of the part of the animal useful for its recognition, the segmentation and extraction of the mask. Successively, feature extraction can be performed, if requested, followed by the individual recognition. Approaches for pattern analysis, recognition, and classification of cetacean's images can help to extract knowledge and to develop innovative models for animal photo identification.

The main stakeholders in the use of these systems are marine biologists, ecologists and marine mammal observers as well as no expert users, such as students and people passionate about the field. Computer-aided systems devoted to photo identification are generally based on computer vision, machine learning and statistics, which provide variety of methods devoted to acquiring, processing and understanding digital images and information that are widely applied in several application domains. Machine learning is a subset of artificial intelligence that is concerned based on the data they use. One of the main drawbacks of machine learning is that there is the need to explicitly express all the knowledge formally, addressing data preprocessing, including cleaning, normalization, scaling, transformation and feature extraction. Automated photo identification systems also exploit the recent concept of deep learning, a part of machine learning, which enables computers to learn and understand the world in terms of a concept hierarchy. With the use of deep learning techniques, it is possible to reduce the data preprocessing impact while increasing the classification performances in multiple domains, including speech and language processing, autonomous driving, health care and medical image processing. Underlying the deep learning revolution, there are some neural network architectures, particularly Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs), such as long short-term memory, which are the basis of the actual empowering of different application domains. Neural networks are a subset of machine learning algorithms, inspired by the human brain, made by layers of artificial neurons, connected to each other, and having an associated weight and threshold. Convolution neural network is a class of neural networks, most commonly applied to analyze visual imagery, while recurrent neural networks are largely employed in hand writing and speech

recognition. The main advantage of these techniques is the ability to learn directly by analyzing raw data, without the need to extract discriminating characteristics in advance. Despite its benefits, neural network training requires a large quantity of data and significant time; moreover, it is a resource-intensive task in recent years, employing statistics and learning techniques in the photo identification task has increased, leading to advances in the field. The main novelty of this paper is systematic review which aims to inform on the state-of-the art application of computer-assisted photo identification for marine mammals, with a specific focus on cetaceans. It aims to identify, analyses and compare the pull of semi-automated and fully automated photo identification systems presented in the modern literature. To the authors' knowledge, there are no previous literature reviews on this topic. This article will also be useful for readers, not experts in statistical learning, who want to try the current state of the automated photo identification of cetaceans.

1.2 SCOPE OF THE PROJECT

The main novelty of this project is a systematic review which aims to inform on the state-of-the-art application of computer-assisted photo identification for marine mammals like whales & dolphins, with a specific focus on cetaceans. It aims to identify analyses and compare the pull of semi-automated and fully automated photo identification systems presented in this system.

1.3 OBJECTIVE

The main stakeholders in the use of these systems are marine biologists, ecologists and marine mammal observers as well as no expert users, such as students and people passionate about the field. Computer-aided systems devoted to photo identification are generally based on computer vision, machine learning and statistics, which provide a variety of methods devoted to acquiring, processing and understanding digital images and information that are widely applied in several application domains.

1.4 EXISTING SYSTEM:

- Weather forecasting has been one of the most challenging problems around the world for more than half a century.
- Not only because of its practical value in meteorology, but it is also a typical “unbiased” time series forecasting problem in scientific research. In this paper, we propose an innovative, intelligent multiagent-based environment, namely intelligent Java Agent Development Environment (I JADE), to provide an integrated and intelligent agent-based platform in the e-commerce environment.
- In addition to the facilities found in contemporary agent development platforms, which focus on the autonomy and mobility of the multiagent, I JADE provides an intelligent layer (known as the “conscious layer”) to implement various AI functionalities in order to produce “smart” agents.

1.4.1 EXISTINGSYSTEM DISADVANTAGES:

- The VGG16 network is that it is a huge network.
- This means that it takes more time to train its parameters.
-

1.5 LITERATURE SURVEY

Title: A survey of the usages of deep learning for natural language processing.

Author: D. W. Otter, J. R. Medina, and J. K. Kalita.

Year: 2021

Description: Over the last several years, the field of natural language processing has been propelled forward by an explosion in the use of deep learning models. This article provides a brief introduction to the field and a quick overview of deep learning architectures and methods. It then sifts through the plethora of recent studies and summarizes a large assortment of relevant contributions. Analyzed research areas include several core linguistic processing issues in addition to many applications of computational linguistics. A discussion of the current state of the art is then provided along with recommendations for future research in the field.

Title: Computer vision technology in agricultural automation A review.

Author: D H. Tian, T. Wang, Y. Liu, X. Qiao, and Y. Li

Year: 2020

Description: Computer vision is a field that involves making a machine “see”. This technology uses a camera and computer instead of the human eye to identify, track and measure targets for further image processing. With the development of computer vision, such technology has been widely used in the field of agricultural automation and plays a key role in its development. This review systematically summarizes and analyzes the technologies and challenges over the past three years and explores future opportunities and prospects to form the latest reference for researchers. Through the analyses, it is found that the existing technology can help the development of agricultural automation for small field farming to achieve the advantages of low cost, high efficiency and high precision. However, there are still major challenges. First, the technology will continue to expand into new application areas in the future, and there will be more technological issues that need to be overcome. It is essential to build large-scale data sets. Second, with the rapid development of agricultural automation, the demand for professionals will continue to grow. Finally, the robust performance of related technologies in various complex environments will also face challenges. Through analysis and discussion, we believe that in the future, computer vision technology will be combined with intelligent technology such as deep learning technology, be applied to every aspect of agricultural production management based on large-scale datasets, be more widely used to solve the current agricultural problems, and better improve the economic, general and robust performance of agricultural automation systems, thus promoting the development of agricultural automation equipment and systems in a more intelligent direction.

Title: The influence of fish farm activity on the social structure of the common bottlenose dolphin in Sardinia (Italy)

Author: S. Frau, F. Ronchetti, F. Perretti, A. Addis, G. Ceccherelli, and G. La Manna

Year: 2021

Description: In a wide variety of habitats, including some heavily urbanized areas, the adaptability of populations of common bottlenose dolphin (*Tursiops truncatus*) may depend on the social structure dynamics. Nonetheless, the way in which these adaptations take place is still poorly understood. In the present study we applied photo-identification techniques to investigate the social structure of the common bottlenose dolphin population inhabiting the Gulf of Alghero (Sardinia, Italy), analyzing data recorded from 2008 to 2019. The social structure analysis showed a division of the entire population into five different communities and the presence of non-random associations, while there was no evidence of segregation between sexes. Furthermore, results highlighted an important change in social structure through time, likely due to a reduction in fish farm activity since 2015. The division of the population into different communities, the presence of segregation based on the foraging strategy (inside or outside the fish farm area) and the social network measures were evaluated by analysing independently the two datasets: the intense and low farm activity periods: 2008–2014 and 2015–2020, respectively. Segregation among individuals belonging to the same foraging strategy class was found only in the earlier period, and the composition of the four communities was consistent with this result. Our study improves the knowledge about bottlenose dolphin adaptation, as a lower complexity in social structure was linked to a reduction in anthropogenic food availability.

Title: Comprehensive evaluation of survival and population growth for common bottlenose dolphins (Tursiops Truncatus) in the Mississippi sound, USA, following the deepwater horizon oil spill.

Author: M. M. Samuelson, M. Fujiwara, E. E. Pulis, J. Pitchford, V. A. Howard, and M. Solangi

Year: 2021

Description: Estimating population parameters such as survival and population growth is critical for the monitoring of at-risk populations of marine mammals. We conducted monthly boat-based photo-identification surveys in the Mississippi Sound and eastern Louisiana waters during January 2011–June 2015 to assess the status of the Mississippi Sound, Lake Borgne, and Bay Boudreau *Tursiops truncatus* (Common Bottlenose Dolphin) stock. Using the resulting mark–recapture data, we estimated the survival and population growth rates using a reverse capture–recapture method. The estimated monthly survival probability over this period of time was 0.969 (95% CI: 0.964–0.974). The final monthly population growth rate was then estimated to be 1.005 (95% CI: 0.998–1.013), which suggests a relatively stable population.

Title: GIS investigation of the relationship of sex and season on the population distribution of common bottlenose dolphins (Tursiops truncatus) in Charleston, South Carolina

Author: H. Bouchillon, N. S. Levine, and P. A. Fair,

Year: 2020

Description: The Charleston Estuarine System Stock (CESS) of common bottlenose dolphins (*Tursiops truncatus*) has been the focus of population monitoring for the past 20 years. Photo-id studies have determined abundance and survival estimates for this population, which exhibits high site fidelity in this area. However, fine-scale distribution, utilization patterns, and the driving forces behind these patterns are lacking. Using historical photo-id data and a novel application of geographic information system (GIS) analysis, the present study identified core use areas within Charleston Harbor, as well as patterns specific to sexes and seasons. Photo-id data of 319 dolphins sighted 11 times or more during 2004–2009 were analyzed. Heat maps were developed to examine spatial distributions using kernel density estimates (KDE) and were compared between sexes and seasons. Multiple high-density core use areas were identified for this population, with the most noteworthy near the mouth of the harbor toward the Atlantic Ocean. Fine-scale distribution varied across sexes, as well as seasons. Some areas were identified as more specifically inhabited by one sex, while other areas overlapped between sexes. Females were more tightly concentrated within their distribution while males were more dispersed. Although population distribution varied across seasons, sex distributions remained.

1.6 PROPOSED SYSTEM

- There was a growing interest among data scientists in developing intelligent systems devoted to supporting experts when conducting cetacean photo identification studies, opening new frontiers and opportunities respect to the manually performed studies.

  The main advantage of manual photo identification is that it exploits human intelligence and experience acquired by experts in the field. For example, a photo scientist trivially solves the problem of having several dolphins in the same photo, as well as of handling the evolution of the distinctive marks of cetaceans that naturally occur in some species over time.
- On the other hand, manual photo identification of cetacean depends on the experience of those who perform the task, and, in case of large numbers of images, is likely to become tedious and very time consuming.
- The research was performed using a panel of fourteen search strings that use relevant keywords.

1.6.1 PROPOSED SYSTEM ADVANTAGES:

- Obtaining an accuracy of individual right whale recognition of 99.77%.
- It can reduce the training time by reducing the number of layers.
- The number of images per individual whale impacted the performance of the last CNN devoted to individual recognition.
- It can improve the efficiency of the model.

CHAPTER 2

PROJECT DESCRIPTION

2.1 GENERAL:

Computer-aided systems have been developed to support researchers during photo identification studies, to reduce the user effort and the time required to perform the study. Data used for cetacean photo ID studies are images containing well-exposed dorsal or caudal fin (depending on the species to be photo-identified) of the animal. So, the images may contain the fin of the animal but also other parts of the body, not useful for its photo identification, and the distance of the animal can vary a lot. Moreover, often in the photos two or more dolphins are captured while swimming together. In addition, the images may also contain other moving objects or parts thereof, such as vessels, other animals (i.e., Birds or turtles), and fixed structures during sightings imports or near the coast.

2.2 METHODOLOGIES

2.2.1MODULES NAME:

MODULE:

- **Dataset**
- **Importing the necessary libraries**
- **Retrieving the images**
- **Splitting the dataset**
- **Building the model**
- **Apply the model and plot the graphs for accuracy and loss**
- **Accuracy on test set**
- **Saving the Trained Model**

2.2.2 MODULES DESCSRIPTION:

1) Dataset:

In the first module, we developed the system to get the input dataset for the training and testing purpose. We have taken the images for Cetacean dataset for Cetacean photo prediction

The dataset consists of more than 50,000 Cetacean images

2) Importing the necessary libraries:

We will be using Python language for this. First we will import the necessary libraries such as keras/ tensorflow for building the main model, sklearn for splitting the training and test data, PIL to open & read images, numpy for converting data into array of numbers & expanding dimensions and other libraries such as pandas, cv2, streamlit and save.

3) Retrieving the images:

We will retrieve the images and their labels. Then resize the images to (64,64) as all images should have same size for recognition. Then convert the images into numpy array.

4) Splitting the dataset:

Split the dataset into train and test. 80% train data and 20% test data.

5) Building the model:

For building the model we will use sequential model from keras/ tensorflow library. Then we will add the layers to make modified convolution neural network. In the first one Conv2D layers we have used 32 filters and the kernel size is (5, 5).

In the 2nd Conv2D layers we have used 64 filters and the kernel size is (3, 3).

In the Batch Norm is a normalization technique done between the layers of a Neural Network instead of in the raw data. It is done along mini-batches instead of the full data set. It serves to speed up training and use higher learning rates, making learning easier.

In the MaxPool2D layer we have kept pool size (3, 3) which means it will select the maximum value of every 3 x 3 area of the image. By doing these dimensions of the image will reduce by factor of 2. In dropout layer we have kept dropout rate = 0.25 that means 25% of neurons are removed randomly.

We apply these starting 2 layers again with some change in parameters. Then we apply flatten layer to convert 2-D data to 1-D vector. This layer is followed by dense layer, dropout layer and dense layer again. The last dense layer outputs 2 nodes as the Cetacean or not. This layer uses the soft max activation function which gives probability value and predicts which of the 2 options has the highest probability.

6) Apply the model and plot the graphs for accuracy and loss:

We will compile the model and apply it using fit function. The batch size will be 100. Then we will plot the graphs for accuracy and loss. We got average validation accuracy of 90.17% and average training accuracy of 90.87%.

7) Accuracy on test set:

We got an accuracy of 90.17% on test set

8) Saving the Trained Model:

Once you're confident enough to take your trained and tested model into the production-ready environment, the first step is to save it into an .h5 file using a library like save.

Make sure you have `save method` installed in your environment.

Next, let's import the module and dump the model into `.h5` file.

2.3 TECHNIQUE USED OR ALGORITHM USED

2.3.1 EXISTING TECHNIQUE: -

❖ **VGG 16:**

- The two-stream framework is adopted by the Feature extraction module of the AVMSN, and audio-visual sources can be incorporated as the input channel for the AVMSN.
- The architecture of the AVMSN is depicted in, from which it can be seen that there are Feature extraction and Multi-modal fusion modules contained in the AVMSN.
- The Feature extraction module consists of the Vision-end and Audio-end stream branches.
- As for the Vision-end branch, the front-end feature is extracted by the popular Visual-VGG network.
-

2.3.2 PROPOSED TECHNIQUE USED OR ALGORITHM USED:

❖ **Modified CNN (conventional neural networks) Architecture:**

- Modified CNN may use a different number of layers or different types of layers than a standard CNN, in order to better capture the specific features.
- The architecture may also include additional techniques such as data augmentation, regularization, or optimization algorithms that are used to improve the training and generalization of the model.
- Successively, the authors developed a network that automatically scales, rotates and crops the input image, producing what they call a passport photo of a whale, that is, a standardized right whale photo with uniform size and orientation, which was used for the final photo identification.

CHAPTER 3

REQUIREMENTS ENGINEERING

3.1 GENERAL

We can see from the results that on each database, the error rates are very low due to the discriminatory power of features and the regression capabilities of classifiers. Comparing the highest accuracies (corresponding to the lowest error rates) to those of previous works, our results are very competitive.

3.2 HARDWARE REQUIREMENTS

The hardware requirements may serve as the basis for a contract for the implementation of the system and should therefore be a complete and consistent specification of the whole system. They are used by software engineers as the starting point for the system design. It should what the system do and not how it should be implemented.

PROCESSOR	:	DUAL CORE 2 DUOS.
RAM	:	4GB DD RAM
HARD DISK	:	250 GB

3.3 SOFTWARE REQUIREMENTS

The software requirements document is the specification of the system. It should include both a definition and a specification of requirements. It is a set of what the system should do rather than how it should do it. The software requirements provide a basis for creating the software requirements specification. It is useful in estimating cost, planning team activities, performing tasks and tracking the teams and tracking the team's progress throughout the development activity.

- Operating System : Windows 7/8/10
- Platform : Spyder3
- Programming Language : Python
- Front End : HTML, CSS

3.4 FUNCTIONAL REQUIREMENTS

A functional requirement defines a function of a software-system or its component. A function is described as a set of inputs, the behavior, firstly, the system is the first that achieves the standard notion of semantic security for data confidentiality in attribute-based deduplication systems by resorting to the hybrid cloud architecture.

3.5 NON-FUNCTIONAL REQUIREMENTS

The major non-functional Requirements of the system are as follows

Usability

The system is designed with completely automated process hence there is no or less user intervention.

Reliability

The system is more reliable because of the qualities that are inherited from the chosen platform python. The code built by using python is more reliable.

Performance

This system is developing in the high-level languages and using the advanced back-end technologies it will give response to the end user on client system with in very less time.

Supportability

The system is designed to be the cross platform supportable. The system is supported on a wide range of hardware and any software platform, which is built into the system.

Implementation

The system is implemented in web environment using Jupyter notebook software. The server is used as the intelligence server and windows 10 professional is used as the platform. Interface the user interface is based on Steam lit provides server system.

CHAPTER 4

DESIGN ENGINEERING

4.1 GENERAL

Design Engineering deals with the various UML [Unified Modelling language] diagrams for the implementation of project. Design is a meaningful engineering representation of a thing that is to be built. Software design is a process through which the requirements are translated into representation of the software. Design is the place where quality is rendered in software engineering.

4.2 UML DIAGRAMS

4.2.1 USE CASE DIAGRAM

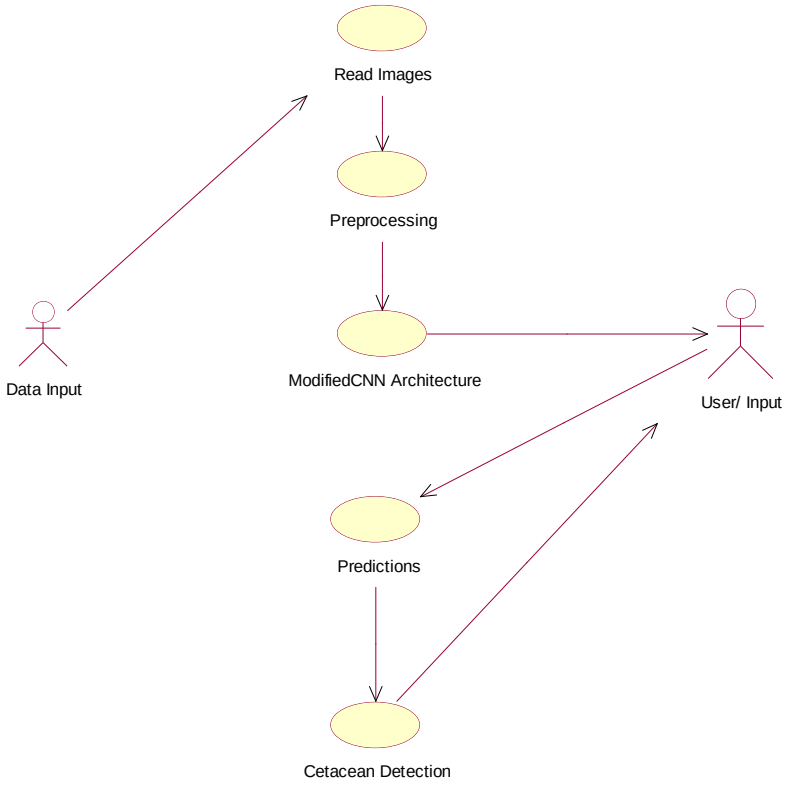


Fig 4.1

EXPLANATION:

The main purpose of a use case diagram is to show what system functions are performed for which actor. Roles of the actors in the system can be depicted. The above diagram consists of user as actor. Each will play a certain role to achieve the concept.

4.2.2 CLASS DIAGRAM

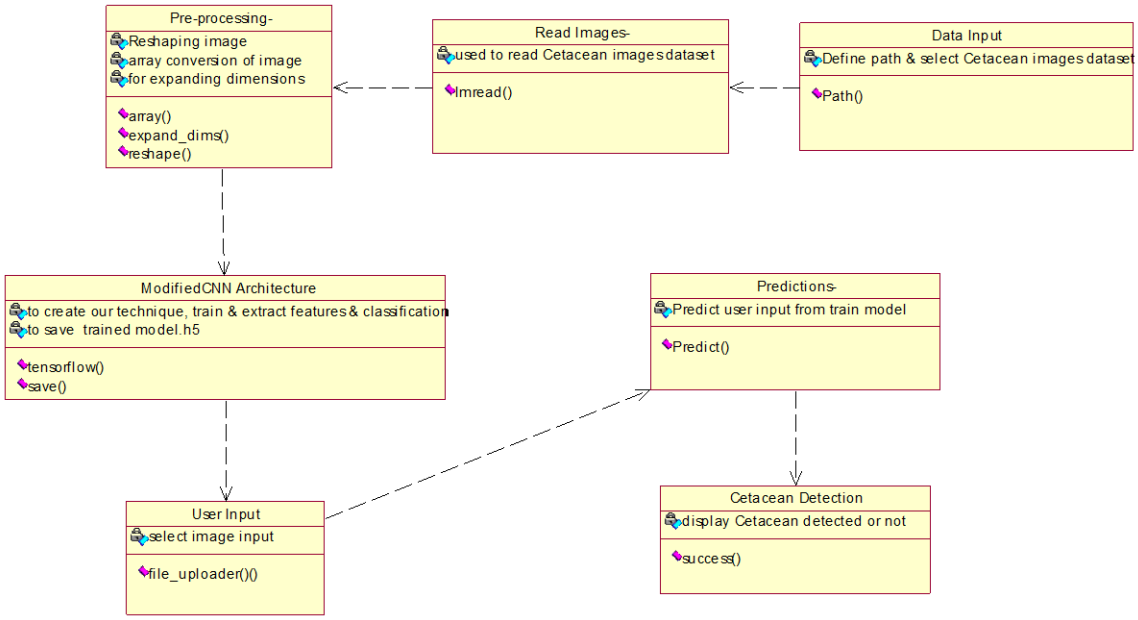


Fig 4.2

EXPLANATION

In this class diagram represents how the classes with attributes and methods are linked together to perform the verification with security. From the above diagram shown the various classes involved in our project.

4.2.3 OBJECT DIAGRAM

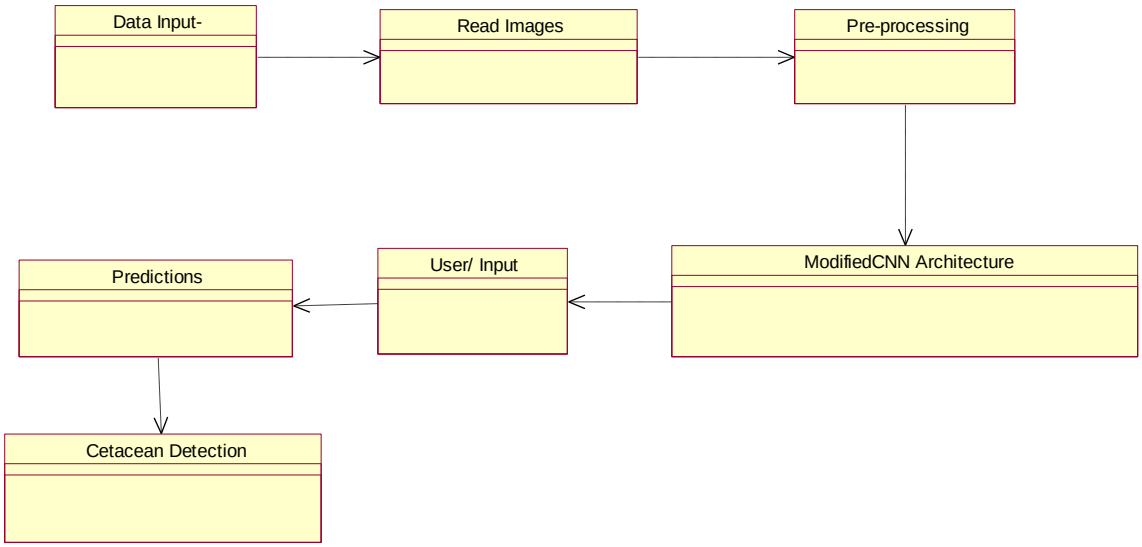


Fig 4.3

EXPLANATION:

In the above digram tells about the flow of objects between the classes. It is a diagram that shows a complete or partial view of the structure of a modeled system. In this object diagram represents how the classes with attributes and methods are linked together to perform the verification with security.

4.2.4 STATE DIAGRAM

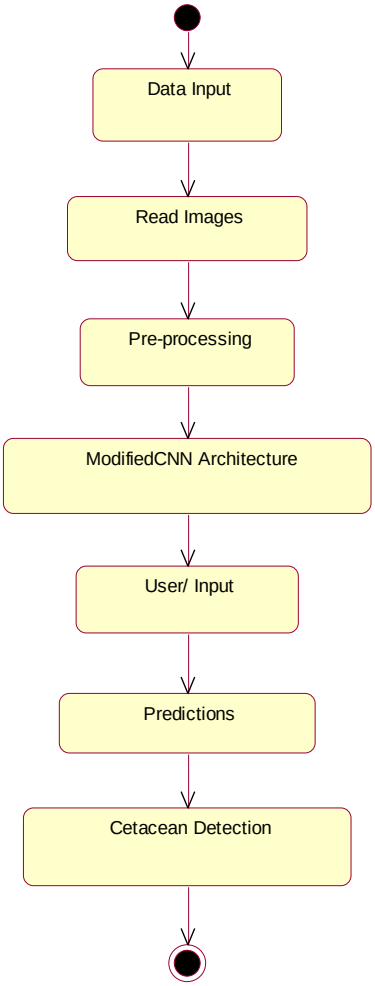


Fig 4.4

EXPLANATION:

State diagram are a loosely defined diagram to show workflows of stepwise activities and actions, with support for choice, iteration and concurrency. State diagrams require that the system described is composed of a finite number of states; sometimes, this is indeed the case, while at other times this is a reasonable abstraction. Many forms of state diagrams exist, which differ slightly and have different semantics.

4.2.5 ACTIVITY DIAGRAM

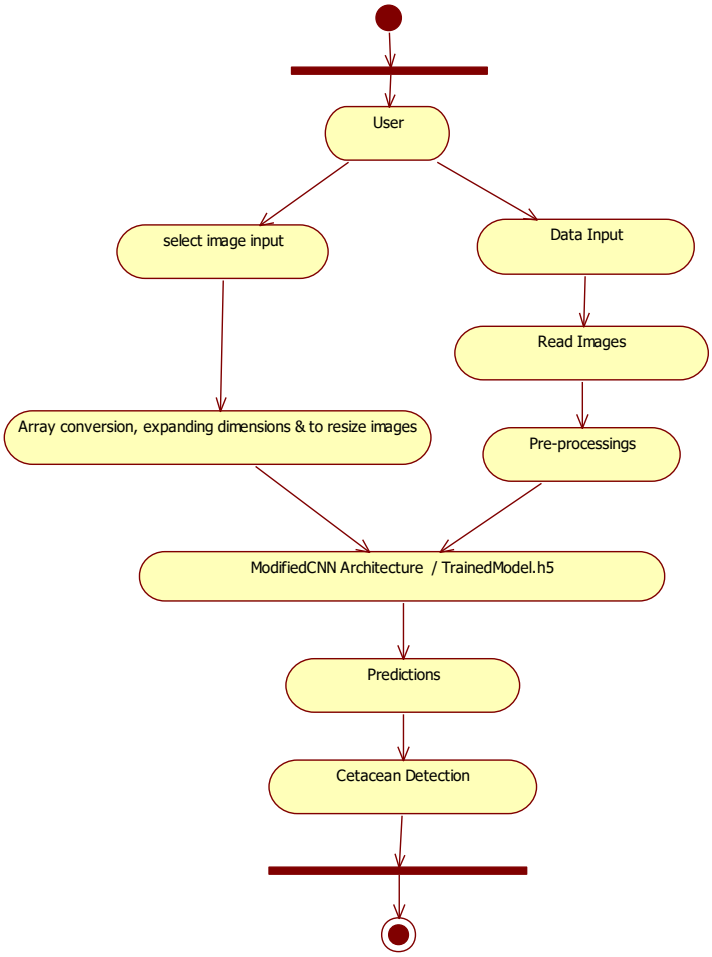


Fig 4. 5

EXPLANATION:

Activity diagrams are graphical representations of workflows of stepwise activities and actions with support for choice, iteration and concurrency. In the Unified Modeling Language, activity diagrams can be used to describe the business and operational step-by-step workflows of components in a system. An activity diagram shows the overall flow of control.

4.2.6 SEQUENCE DIAGRAM

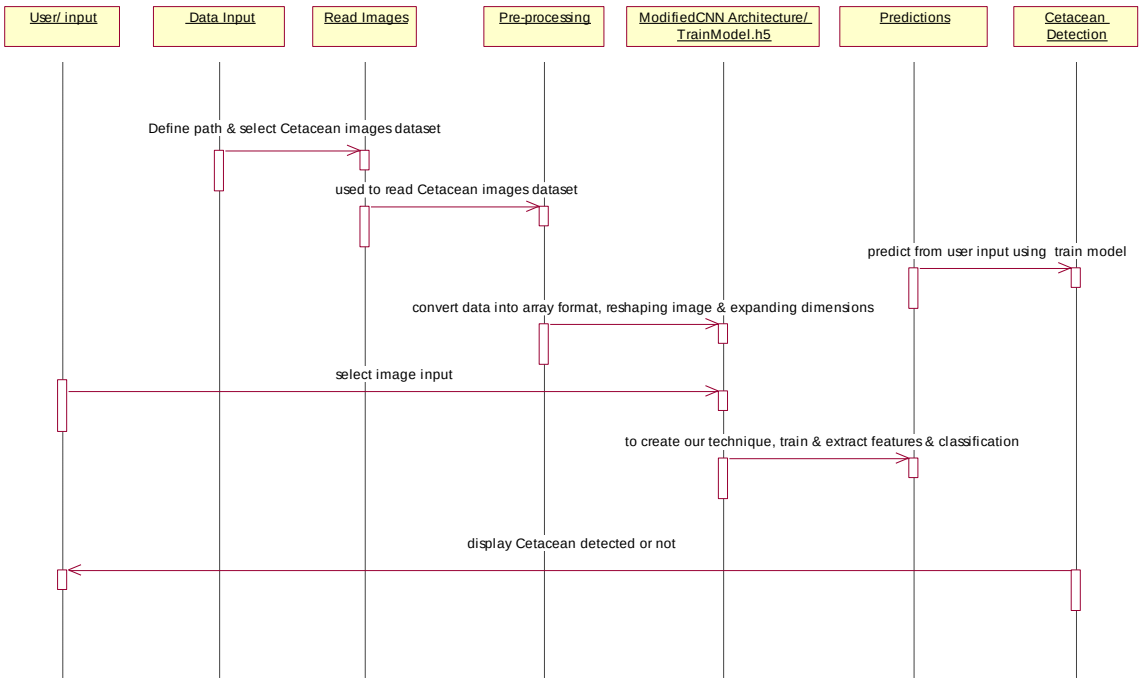


Fig 4. 6

EXPLANATION:

A sequence diagram in Unified Modeling Language (UML) is a kind of interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence Chart. A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario.

4.2.7 COLLABORATION DIAGRAM

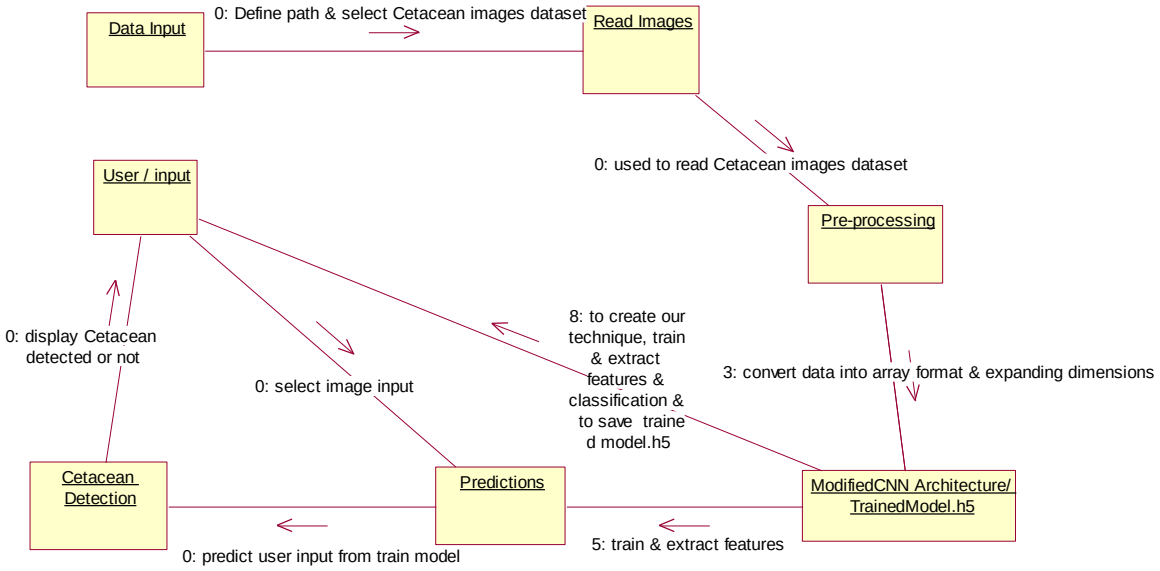


Fig 4.7

EXPLANATION:

A collaboration diagram, also called a communication diagram or interaction diagram, is an illustration of the relationships and interactions among software objects in the Unified Modeling Language (UML). The concept is more than a decade old although it has been refined as modeling paradigms have evolved.

4.2.8 COMPONENT DIAGRAM

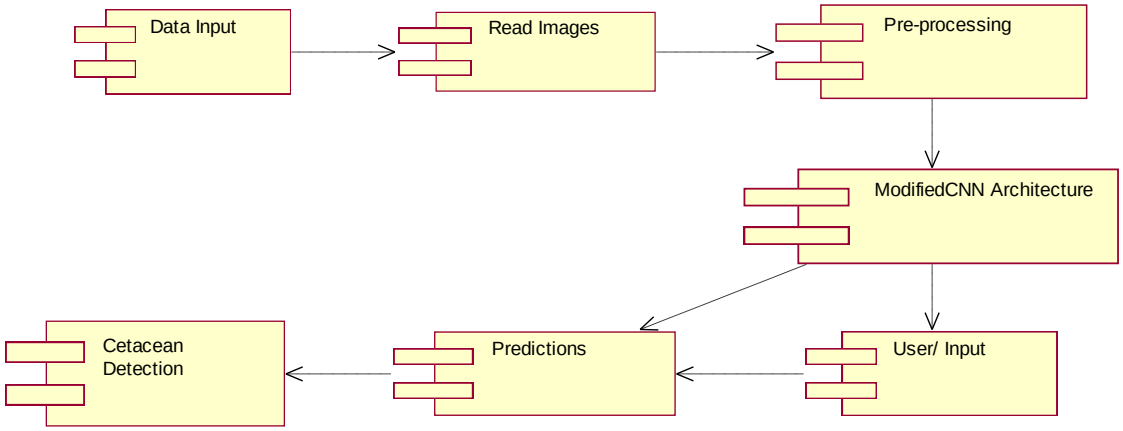


Fig 4.8

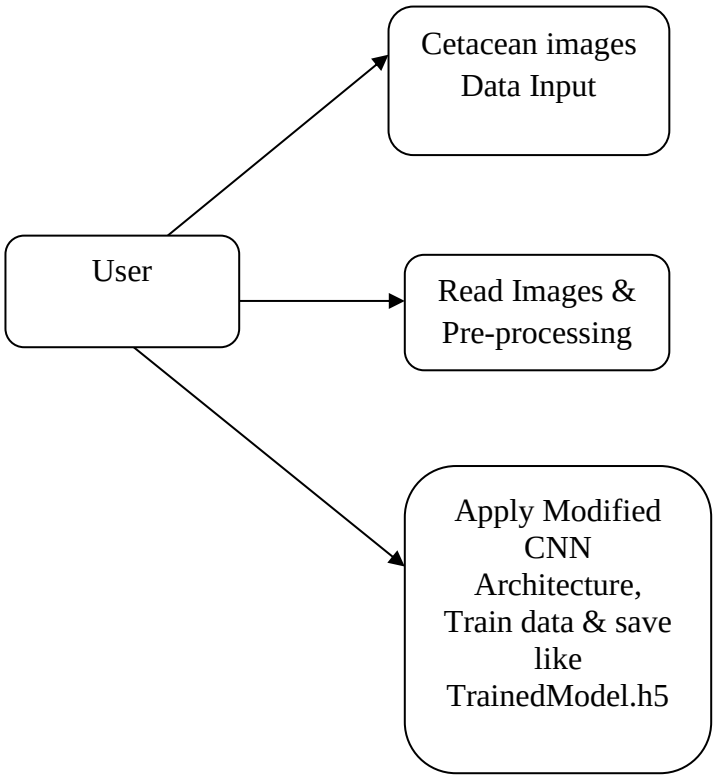
EXPLANATION

In the Unified Modeling Language, a component diagram depicts how components are wired together to form larger components and or software systems. They are used to illustrate the structure of arbitrarily complex systems. User gives main query and it converted into sub queries and sends through data dissemination to data aggregators. Results are to be showed to user by data aggregators. All boxes are components and arrow indicates dependencies.

4.2.9 Data Flow Diagram

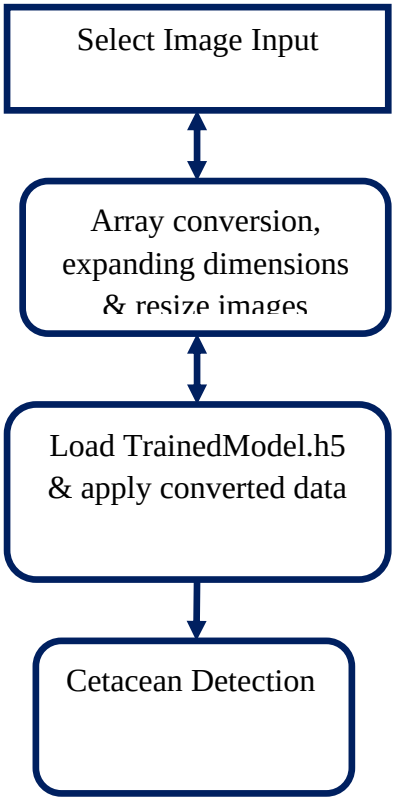
Level 0and Level 01

Fig 4.9



Level 1

Fig 4.9.1



4.2.10 DEPLOYMENT DIAGRAM

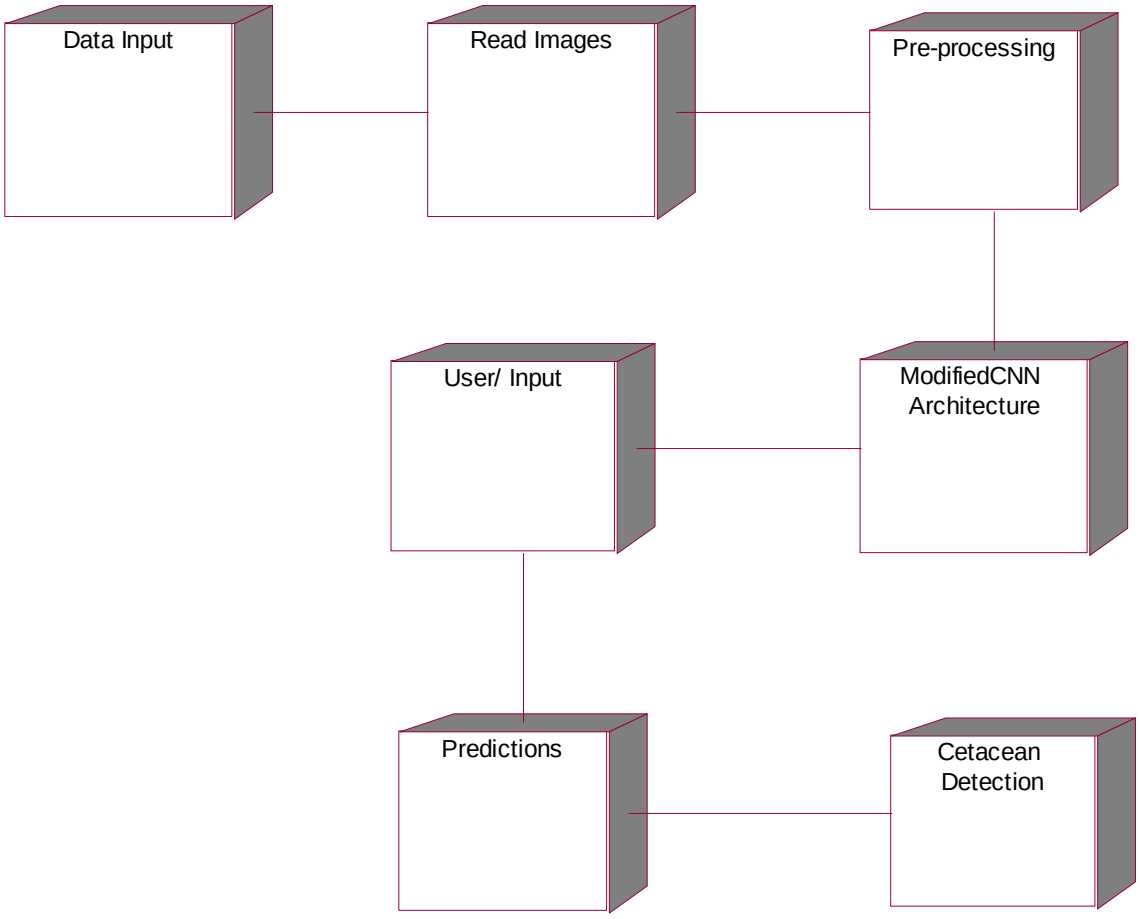


Fig 4.10

EXPLANATION:

Deployment Diagram is a type of diagram that specifies the physical hardware on which the software system will execute. It also determines how the software is deployed on the underlying hardware. It maps software pieces of a system to the device that are going to execute it.

ARCHITECTURE:

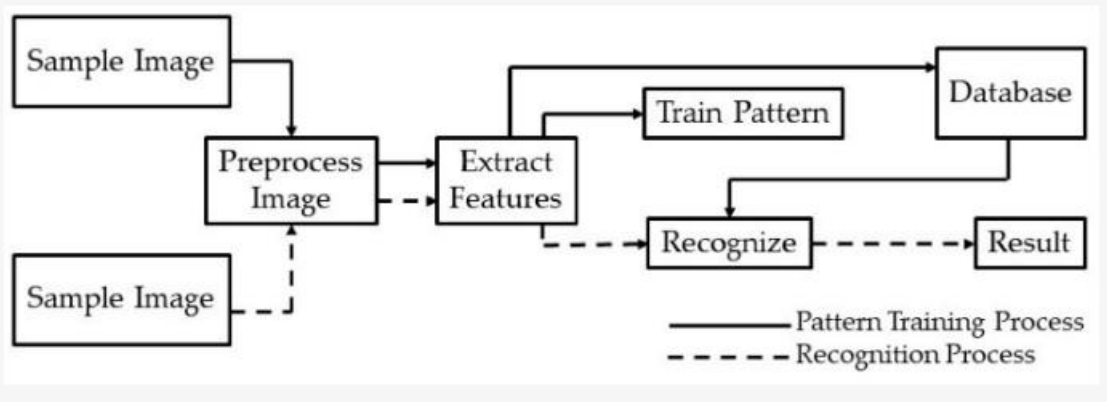


Fig 4.11: System Architecture

CHAPTER 5

DEVELOPMENT TOOLS

5.1 Python

Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. It uses English keywords frequently where as other languages use punctuation, and it has fewer syntactical constructions than other languages.

5.2 History of Python

Python was developed by Guido van Rossum in the late eighties and early nineties at the National Research Institute for Mathematics and Computer Science in the Netherlands.

Python is derived from many other languages, including ABC, Modula-3, C, C++, Algol-68, SmallTalk, and Unix shell and other scripting languages.

Python is copyrighted. Like Perl, Python source code is now available under the GNU General Public License (GPL).

Python is now maintained by a core development team at the institute, although Guido van Rossum still holds a vital role in directing its progress.

5.3 Importance of Python

- **Python is Interpreted** − Python is processed at runtime by the interpreter. You do not need to compile your program before executing it. This is similar to PERL and PHP.
- **Python is Interactive** − You can actually sit at a Python prompt and interact with the interpreter directly to write your programs.
- **Python is Object-Oriented** − Python supports Object-Oriented style or technique of programming that encapsulates code within objects.

- **Python is a Beginner's Language** − Python is a great language for the beginner-level programmers and supports the development of a wide range of applications from simple text processing to WWW browsers to games.

5.4 Features of Python

- **Easy-to-learn** − Python has few keywords, simple structure, and a clearly defined syntax. This allows the student to pick up the language quickly.
- **Easy-to-read** − Python code is more clearly defined and visible to the eyes.
- **Easy-to-maintain** − Python's source code is fairly easy-to-maintain.
- **A broad standard library** − Python's bulk of the library is very portable and cross-platform compatible on UNIX, Windows, and Macintosh.
- **Interactive Mode** − Python has support for an interactive mode which allows interactive testing and debugging of snippets of code.
- **Portable** − Python can run on a wide variety of hardware platforms and has the same interface on all platforms.
- **Extendable** − You can add low-level modules to the Python interpreter. These modules enable programmers to add to or customize their tools to be more efficient.
- **Databases** − Python provides interfaces to all major commercial databases.
- **GUI Programming** − Python supports GUI applications that can be created and ported to many system calls, libraries and windows systems, such as Windows MFC, Macintosh, and the X Window system of Unix.
- **Scalable** − Python provides a better structure and support for large programs than shell scripting.

Apart from the above-mentioned features, Python has a big list of good features, few are listed below −

- It supports functional and structured programming methods as well as OOP.
- It can be used as a scripting language or can be compiled to byte-code for building large applications.
- It provides very high-level dynamic data types and supports dynamic type checking.
- IT supports automatic garbage collection.
- It can be easily integrated with C, C++, COM, ActiveX, CORBA, and Java.

5.5 Libraries used in python

- numpy - mainly useful for its N-dimensional array objects.
- pandas - Python data analysis library, including structures such as data frames.
- matplotlib - 2D plotting library producing publication quality figures.
- scikit-learn - the machine learning algorithms used for data analysis and data mining tasks.

Figure : NumPy, Pandas, Matplotlib, Scikit-learn

CHAPTER 6

IMPLEMENTATION

6.1 GENERAL

Coding:

```
import os
import sys
import numpy as np
import cv2
from PIL import Image, ImageOps

import streamlit as st
from streamlit_option_menu import option_menu

from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image
from tensorflow.keras.preprocessing.image import load_img

from werkzeug.utils import secure_filename


# Load model
model = load_model("ModifiedCNN.h5")



st.write("""
         # Cetacean Photo Identification
         """
         )

st.write("Machine Learning and Image Processing Methods for Cetacean Photo Identification: A Systematic Review")


#if selection == "Home":
```

```
with st.expander("Home"):

    st.title("Machine Learning and Image Processing Methods for Cetacean Photo
Identification: A Systematic Review")
    homelogo = Image.open(r'css/cetacean_photo.jpg')
    st.image(homelogo, width=700)

#if selection == "Performace":
with st.expander("Performance"):

    st.title("Performance on Cetacean Photo Identification")
    st.markdown("<h1   style='text-align:   center;   font-size:   20px;   color:
blue;'>Modified Convolutional Neural Network Architecture</h1>"
                , unsafe_allow_html=True)
    st.markdown("<h1   style='text-align:   center;   font-size:   20px;   color:
lime;'>Accuracy % Score: 99.8</h1>"
                , unsafe_allow_html=True)
    performaceimg = Image.open(r'css/training_graph.png')
    st.image(performaceimg, width=700)


file = st.sidebar.file_uploader("Please upload an image file", type=["jpg", "png",
"jpeg"])


def transform_img(file_path):
    print(file_path)
    img = image.load_img(file_path, target_size=(224, 224))

    # Preprocessing the image
    x = np.array(img)
    # x = np.true_divide(x, 255)
    ## Scaling
    x=x/255
    x = np.expand_dims(x, axis=0)
    return x


# Main function:
def main():
    if file is None:

        st.text("No Input Given? Please upload an image file")
```

```
    else:
        uploadedImage = Image.open(file)
        uploadedImage = uploadedImage.resize((600, 400))
        st.image(uploadedImage, use_column_width=True)
        # Save the file path from ./test
        basepath = os.path.dirname(os.path.realpath(__file__))
        file_path = os.path.join(basepath, 'test', secure_filename(file.name))

        transform_img_data = transform_img(file_path)

        if st.sidebar.button("submit"):
            prediction = model.predict(transform_img_data)
            # st.success(prediction)
            preds=np.argmax(prediction, axis=1)
            # st.success(preds)

            if np.argmax(prediction) == 0:
                st.sidebar.success("\n Detected: Marine Fissipeds")
            elif np.argmax(prediction) == 1:
                st.sidebar.success("\n Detected: Pinnipeds")
            elif np.argmax(prediction) == 2:
                st.sidebar.success("\n Detected: Cetacean Detected")


if __name__ == '__main__':
    main()
```

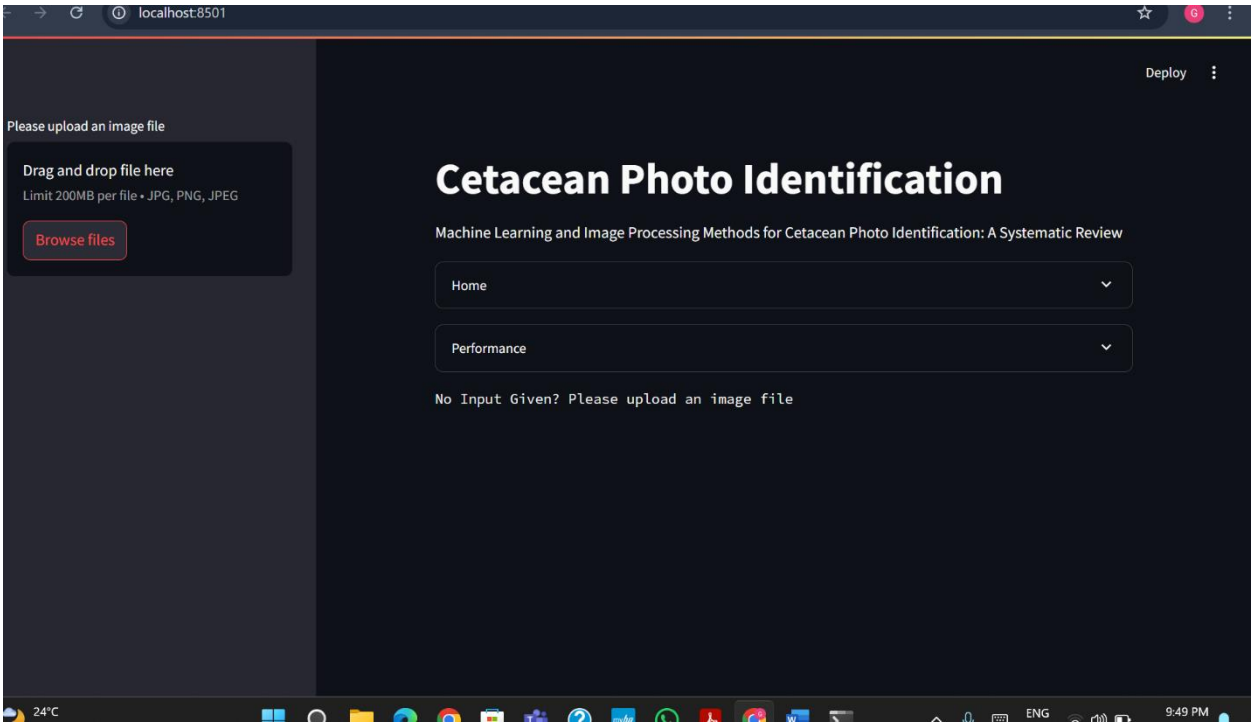
CHAPTER 7

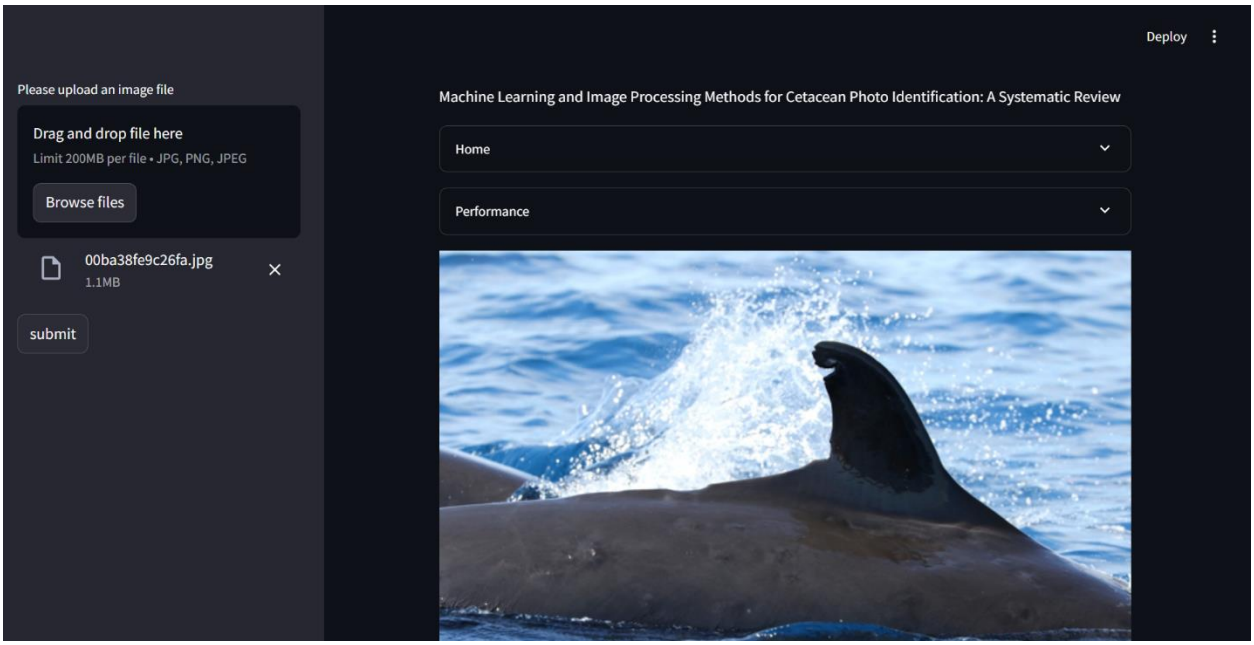
SNAPSHOTS

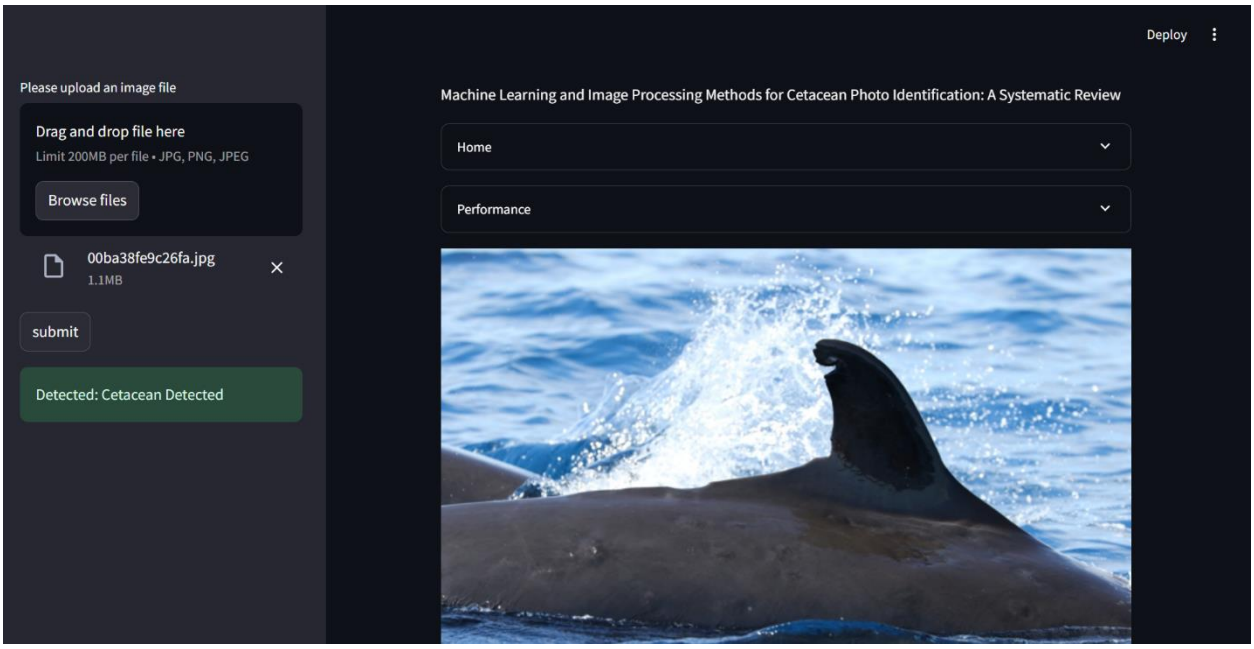
General:

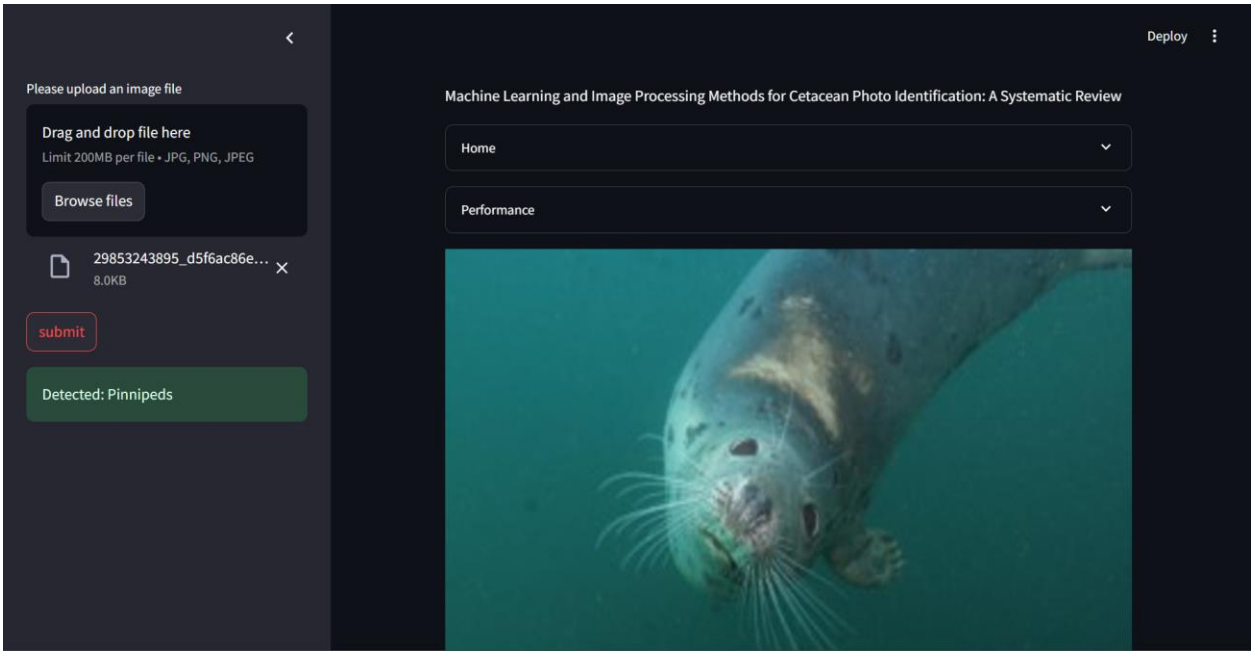
This project is implements like application using python and the Server process is maintained using the SOCKET & SERVERSOCKET and the Design part is played by Cascading Style Sheet.

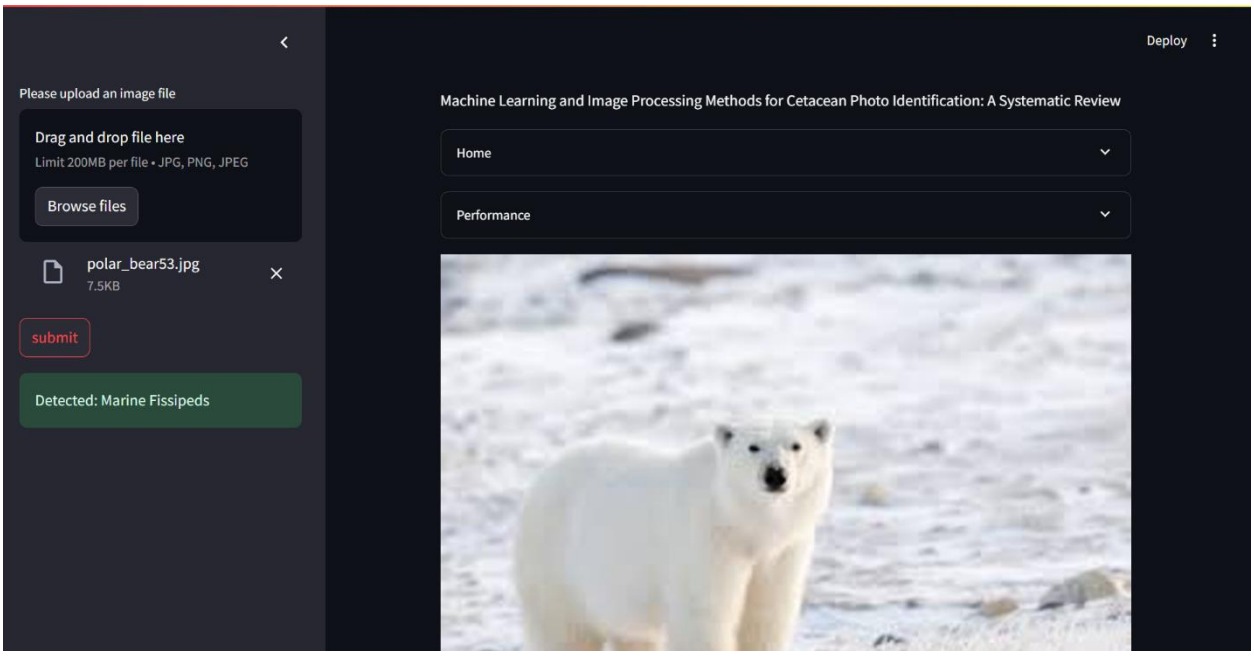
SNAPSHOTS




Deploy
Please upload an image file
Drag and drop file here
Limit 200MB per file • JPG, PNG, JPEG
Browse files
00ba38fe9c26fa.jpg
1.1MB
submit
Machine Learning and Image Processing Methods for Cetacean Photo Identification: A Systematic Review
Home
Performance


Deploy
Please upload an image file
Drag and drop file here
Limit 200MB per file • JPG, PNG, JPEG
Browse files
00ba38fe9c26fa.jpg
1.1MB
submit
Detected: Cetacean Detected
Machine Learning and Image Processing Methods for Cetacean Photo Identification: A Systematic Review
Home
Performance


Please upload an image file
Drag and drop file here
Limit 200MB per file • JPG, PNG, JPEG
Browse files
29853243895_d5f6ac86e...
8.0KB
submit
Detected: Pinnipeds
Deploy
Machine Learning and Image Processing Methods for Cetacean Photo Identification: A Systematic Review
Home
Performance


Please upload an image file
Drag and drop file here
Limit 200MB per file • JPG, PNG, JPEG
Browse files
polar_bear53.jpg
7.5KB
submit
Detected: Marine Fissipeds
Deploy
Machine Learning and Image Processing Methods for Cetacean Photo Identification: A Systematic Review
Home
Performance

CHAPTER 8

SOFTWARE TESTING

8.1 GENERAL

The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components, sub-assemblies, assemblies and/or a finished product It is the process of exercising software with the intent of ensuring that the Software system meets its requirements and user expectations and does not fail in an unacceptable manner. There are various types of test. Each test type addresses a specific testing requirement.

8.2 DEVELOPING METHODOLOGIES

The test process is initiated by developing a comprehensive plan to test the general functionality and special features on a variety of platform combinations. Strict quality control procedures are used. The process verifies that the application meets the requirements specified in the system requirements document and is bug free. The following are the considerations used to develop the framework from developing the testing methodologies.

8.3Types of Tests

8.3.1 Unit testing

Unit testing involves the design of test cases that validate that the internal program logic is functioning properly, and that program input produce valid outputs. All decision branches and internal code flow should be validated. It is the testing of individual software units of the application .it is done after the completion of an individual unit before integration. This is a structural testing, that relies on knowledge of its construction and is invasive. Unit tests perform basic tests at component level and test a specific business process, application, and/or system configuration. Unit tests ensure that each unique path of a business process performs accurately to the documented specifications and contains clearly defined inputs and expected results.

8.3.2 Functional test

Functional tests provide systematic demonstrations that functions tested are available as specified by the business and technical requirements, system documentation, and user manuals. Functional testing is centered on the following items:

Valid Input : identified classes of valid input must be accepted.

Invalid Input : identified classes of invalid input must be rejected.

Functions : identified functions must be exercised.

Output : identified classes of application outputs must be exercised.

Systems/Procedures: interfacing systems or procedures must be invoked.

8.3.3 System Test

System testing ensures that the entire integrated software system meets requirements. It tests a configuration to ensure known and predictable results. An example of system testing is the configuration oriented system integration test. System testing is based on process descriptions and flows, emphasizing pre-driven process links and integration points.

8.3.4 Performance Test

The Performance test ensures that the output be produced within the time limits,and the time taken by the system for compiling, giving response to the users and request being send to the system for to retrieve the results.

8.3.5 Integration Testing

Software integration testing is the incremental integration testing of two or more integrated software components on a single platform to produce failures caused by interface defects.

The task of the integration test is to check that components or software applications, e.g. components in a software system or – one step up – software applications at the company level – interact without error.

8.3.6 Acceptance Testing

User Acceptance Testing is a critical phase of any project and requires significant participation by the end user. It also ensures that the system meets the functional requirements.

Acceptance testing for Data Synchronization:

- The Acknowledgements will be received by the Sender Node after the Packets are received by the Destination Node
- The Route add operation is done only when there is a Route request in need
- The Status of Nodes information is done automatically in the Cache Updation process

8.3.7 Build the test plan

Any project can be divided into units that can be further performed for detailed processing. Then a testing strategy for each of this unit is carried out. Unit testing helps to identity the possible bugs in the individual component, so the component that has bugs can be identified and can be rectified from errors.

CHAPTER 9

FUTURE ENHANCEMENT

9.1 FUTURE ENHANCEMENTS:

Moreover, future research could be focused on the comparison of some of the cited automated systems of cetacean photo ID over the same dataset, discussing how system performances are influenced by several factors, such as image quality, distance to the animal, device used for the image acquisition, using cropped fin image or full image. In particular, a special focus of these studies could be devoted to the evaluation of the ability of those systems of identifying dolphins or whales whose natural markers, used as features of recognition, change quickly. In fact, to the best of our knowledge, the problem of evaluation on how the temporal evolution of natural markers of an animal affects the system performance, during the photo identification process, has not yet discussed in the literature.

CHAPTER 10

CONCLUSIONAND REFERENCES

10.1 CONCLUSION

The main advantage of manual photo identification is that it exploits human intelligence and experience acquired by experts in the field. For example, a photo scientist trivially solves the problem of having several dolphins in the same photo, as well as of handling the evolution of the distinctive marks of cetaceans that naturally occur in some species over time. On the other hand, manual photo identification of cetacean depends on the experience of those who perform the task, and, in case of large numbers of images, is likely to become tedious and very time consuming. To support photo scientists and general users during photo identification process, some interesting approaches, based on advanced statistical methods and machine learning strategies, have been proposed and showed good accuracies in the individual identification of several species of dolphins and whales, with a degree of automation variable among studies. It is widely employed in the photo ID of bottlenose dolphin with very good accuracy, but It can be applied also to different species. For whale photo identification, modified CNNs architecture provides interesting solutions to this task. However, no advanced system can be here recommended, and further studies on this topic are surely desirable. This can be also attributable to the fact that whale sightings are rarer than dolphin sightings in many study areas, and for this few data on whale are available for training machine learning systems. Moreover, modified CNNs architecture has been successfully applied to automated recognition of whale species with a good degree of automation and performance. Additionally, in this case, freely accessible data should increase the number of studies on this matter, which is before limited. Finally, our study highlights that some benefits come from citizen science activities, which provide researchers with a larger amount of data, particularly nonprofessional images acquired by the general public, which can successfully be used in photo identification studies.

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