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Pattern Recognition for Identifying Marine Animals

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ABSTRACT-

The field of marine ecology has benefited from the use of deep learning techniques for analyzing complex data obtained from corals, cameras, and acoustic sensors in real-time. One of the main challenges in this field is the detection of marine animals due to the complexity of underwater background, image quality, and diverse motions of marine animals. To address this challenge, deep learning-based techniques have been used for detecting specific marine animals with bounding boxes in the given images. This approach has been implemented in several case studies involving object detection, classification, tracking, and segmentation of visualized data related to plankton, fishes, marine mammals, and nutrient cycling. Despite several opportunities and challenges in this field, the use of deep learning techniques has shown promising results and can ultimately help in protecting the marine ecosystem.

Keywords— Convolutional Neural Network, Pattern recognition Semantic segmentation, Support vector machines.

Introduction-

Pattern recognition technology can indeed be an effective tool for optimizing marine animal detection programs, as it can help to automate the analysis of underwater images and improve the accuracy of detection and classification. There are several approaches to pattern recognition, including machine learning algorithms such as convolutional neural networks (CNNs) and support vector machines (SVMs), as well as traditional computer vision techniques such as edge detection and image segmentation. To optimize the detection program, it considers using a combination of these techniques, depending on the specific characteristics of your data and the types of marine animals you are trying to detect. For example, CNNs are often used for object recognition in images, while edge detection can help to identify the boundaries of objects and image segmentation can be used to group pixels into meaningful regions. Another important consideration is real-time performance. To achieve high performance and accuracy, specialized hardware such as GPUs or FPGAs to accelerate the processing of images are used. Optimization of algorithms for parallel processing takes advantage of these hardware resources. Additionally, it is important to have high-quality training data to train the pattern recognition models. This means collecting a large and diverse dataset of images that accurately represents the marine animals we are trying to detect. The images need to be labelled with correct classifications to train the models effectively. Additionally, it is important to have high-quality training data to train your pattern recognition models. This means collecting a large and diverse dataset of images that accurately represents the marine animals you are trying to detect. You may also need to label the images with the correct classifications to train your models effectively. It is also important to note that pattern recognition technology is not a replacement for human expertise and observation. While these tools can improve the accuracy and efficiency of marine animal detection programs, they should be used as a complementary tool to human observation and monitoring efforts. Overall, optimizing a marine animal detection program using pattern recognition technology requires careful consideration of the data, the algorithms used, and the performance requirements. With the right approach, pattern recognition technology can be a powerful tool to improve the accuracy and efficiency of marine animal detection programs.

Literature Survey

Southwest Fisheries Science Center Surveys (SWFSC), conducts visual surveys to estimate cetacean abundance. SWFSC has been using combined visual and acoustic techniques to monitor marine mammal populations for the past eight years. In case study in dolphins for counting marine mammals using vocalizations is explained. In 2000 passive acoustic monitoring was integrated into SWFSC survey methods. In automated marine mammals detection using aerial imagery is explained.

Color analysis based on working principle and histogram-based shape profiling algorithms are used. XBAT, ERMA, GMM detector, and FMCD detector are the detection algorithms which are used for detection purpose. Most of these are not open source and not freely available. Holger Klincka et al. in proposed, the energy ratio mapping algorithm (ERMA) to improve the performance of energy-based detection of odontocete echolocation clicks, especially for application in environments with limited computational power and energy such as acoustic gliders. ERMA evaluates many frequency bands for energy ratio-based detection of echolocation clicks. Peter Dobbins in proposed, spectrogram correlation is used for click detection. Spectrogram correlation is an effective and widely used technique for detecting and classifying cetacean echolocation clicks. Different species operate in different frequency bands, different spectral templates are needed to detect them. V. Kandia et al. in proposed, the development of an algorithm for automatic detection of sperm whale clicks in large recordings is described. It is based on the Teager Kaiser (TK) energy operator and it is able to detect efficiently creaks as well as regular clicks. David K. Mellinger et aLin proposed, how matched filtering and spectrogram correlation are used for automatic recognition of low frequency sound of baleen whales are described. Matched filtering is implemented with a synthetic filter kernel derived from measurements of whale sounds, and this method is effective at detecting a blue whale sound.

EXISTING SYSTEM

Firstly, the low accuracy of the system may be due to improper image quality. One possible solution could be to improve the quality of the images being processed by using higher resolution cameras or adjusting the lighting conditions. Secondly, it seems that the classification results are not accurate. This may be due to limitations in the image processing technique being used. One possible solution could be to explore more advanced techniques such as machine learning algorithms that can learn to recognize patterns and features in the images more accurately. Thirdly, the system does not recognize the shape of the animals. This may be a significant limitation as the shape of marine animals can be an important factor in distinguishing different species. One possible solution could be to incorporate shape recognition algorithms into the system.

Finally, the long computational time may be a significant bottleneck for the system. One possible solution could be to optimize the image processing and classification algorithms to reduce the computational load or to use more powerful hardware to speed up the processing.

PROPOSED SYSTEM

The proposed system aims to detect marine animals using image analysis and pattern recognition techniques. The system uses a dataset of marine animal images, which is used to train and test the model. The dataset may be collected through a variety of methods, such as underwater cameras or satellite imagery, and should ideally be diverse and representative of the types of marine animals that the system will encounter in the real world. The images in the dataset are pre-processed and trained using the proposed model. The pre-processing stage may involve a range of techniques, such as image filtering, segmentation, and feature extraction. The proposed model may use a variety of machine learning algorithms, such as convolutional neural networks (CNNs), to classify the images based on their features. Once the model is trained, it can be used to classify input images of marine animals using pattern recognition methods. The input images may be pre-processed to enhance their features or to remove noise or artifacts that could affect the model's performance. The classification model then uses the learned features to identify the type of marine animal in the image. The proposed system has a range of potential applications in marine biology and conservation. For example, it could be used to monitor populations of endangered or invasive species, to study the behavior of different marine animals, or to track the effects of climate change on marine ecosystems. The system could also be integrated with other technologies, such as unmanned aerial vehicles (UAVs) or autonomous underwater vehicles (AUVs), to collect and analyze images of marine animals in real time. However, there are several important considerations to keep in mind when developing and testing such a system. One key challenge is ensuring that the image dataset used for training and testing is representative of the types of marine animals that the system will encounter in the real world. If the dataset is biased or incomplete, the model may not perform well on new, unseen images. Another important consideration is the accuracy and reliability of the model. The performance of the model should be carefully evaluated using a range of metrics, such as precision, recall, and F1 score, to ensure that it is accurate and reliable. The model may also need to be regularly retrained or updated as new data becomes available. The proposed system for detecting marine animals using pattern recognition methods has the potential to be a valuable tool for marine biology and conservation. However, careful attention should be paid to developing and testing the system to ensure that it is accurate, reliable, and representative of the types of marine animals that the system will encounter in the real world

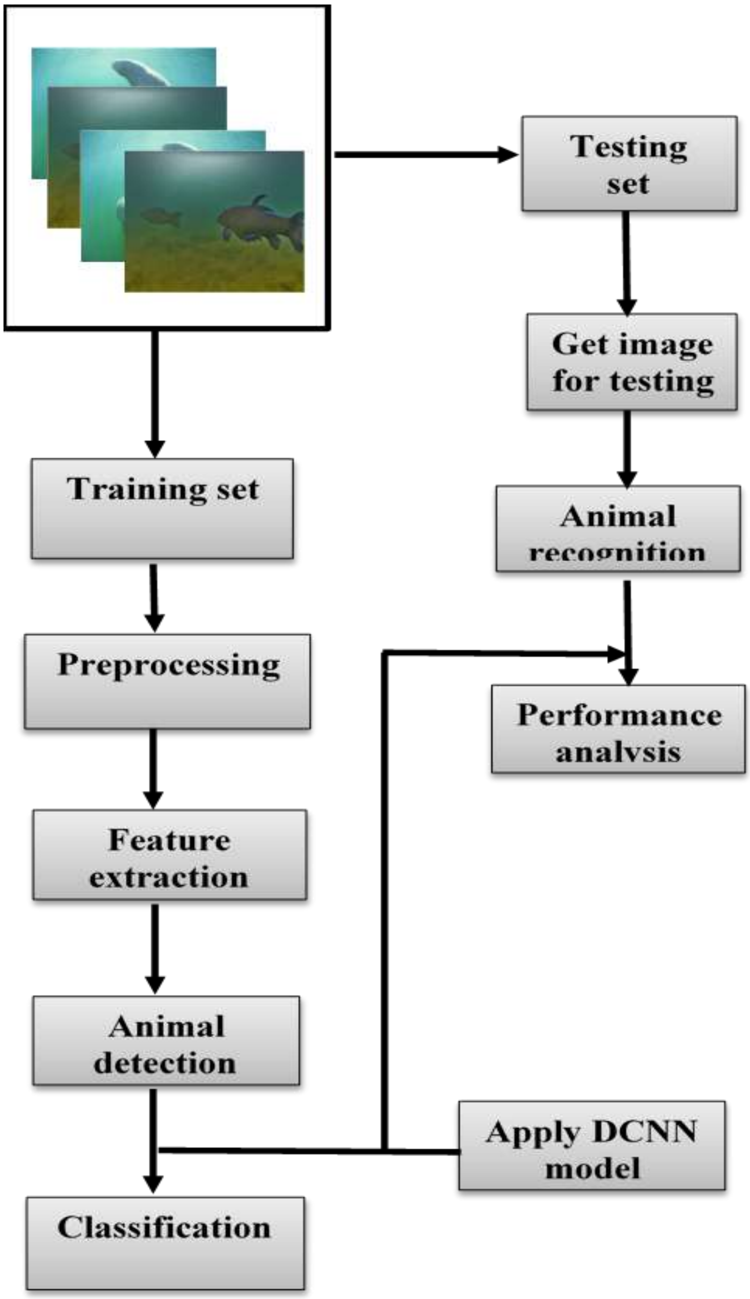
SYSTEM DESIGN

An allocated arrangement of physical elements which provides the design solution for a consumer system architecture or systems architecture is the conceptual model that defines the structure, behavior, and more views of a system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system. System architecture can comprise system components, the externally visible properties of those components, the relationships (e.g. the behavior) between them. It can provide a plan from which products can be procured, and systems developed, that will work together to implement the overall system. There have been efforts to formalize languages to describe system architecture; collectively these are called architecture description languages (ADLs).

Various organizations define systems architecture in different ways, including:

- An allocated arrangement of physical elements which provides the design solution for a consumer product or life-cycle process intended to satisfy the requirements of the functional architecture and the requirements baseline.
- Architecture comprises the most important, pervasive, top-level, strategic inventions, decisions, and their associated rationales about the overall structure (i.e., essential elements and their relationships) and associated characteristics and behavior.
- If documented, it may include information such as a detailed inventory of current hardware, software and networking capabilities; a description of long-range plans and priorities for future purchases, and a plan for upgrading and/or replacing dated equipment and software

- The composite of the design architectures for products and their life-cycle processes.

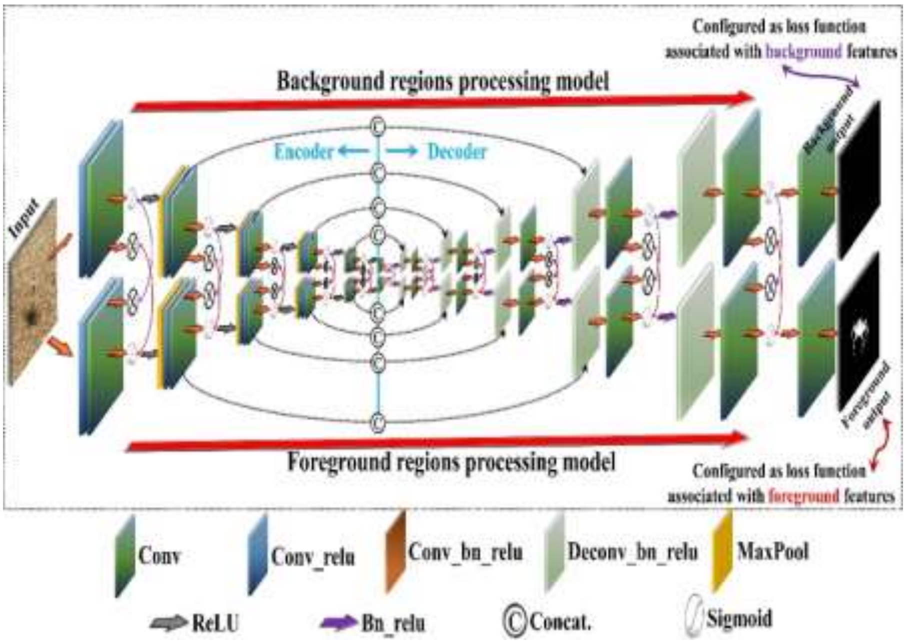


MODULE DESCRIPTION

- **Image Acquisition**
- **Preprocessing**
- **Feature extraction**
- **Classification**
- **Result**

Image Acquisition

The procedure of gathering multiple datasets from various sources for the training and testing datasets can be carried out during this input stage. Then, the earlier works typically depend on a broad range of analytical tools, starting with frame.



It varies from conventional methods, though, in that thermal images are used as inputs. The practice of processing digital pictures using a computer falls under the umbrella of digital image processing. The picture elements, image elements, pixels, and other terms for the finite number of elements that make up a digital image, each of which has a specific position and value, are used interchangeably. The proposed system using a "Brackish underwater dataset" which is retrieved from Kaggle website. It contains the 14,674 marine images. This dataset is split into training and testing process.

PREPROCESSING

At that point, all files have undergone pre-processing. Blurring can be eliminated and the image can be converted to grayscale during pre-processing. The pre-processing method's primary step is used to separate the important characteristics. In the past few decades, the academic community has made significant advancements in the area of background subtraction.

The simplest approach merely models the static backdrop using a statistical measure, such as median or mean over multiple frames. By changing the low-rank structure of just one frame at a time, these online models can significantly speed up.

FEATURE EXTRACTION

Feature extraction is a process of dimensionality reduction by which an initial set of raw data is reduced to more manageable groups for processing. A characteristic of these large data sets is a large number of variables that require a lot of computing resources to process. Feature extraction is the name for methods that select and /or combine variables into features, effectively reducing the amount of data that must be processed, while still accurately and completely describing the original data set. The DCNN method is used in proposed system. DCNN is used to learn a hierarchy of features from low- to high-level concepts. The first step is to magnify the feature maps, and the other is to reduce the convolution layers. A max pooling layer is added in the shallow layers to achieve down-sampling.

The deep convolutional layer is added to perform up-sampling; through these procedures, more semantic information is retained and the hyper features are obtained by local response normalization (LRN) calculation. Additionally, the NMS (Nonmaximal Suppression) method is applied to reduce the duplication. The feature map dimension is reduced to speed up the computation.

CLASSIFICATION

The classification is implemented based on deep learning algorithms: Deep Convolutional Neural Network (DCNN), to evaluate the efficiency of deep learning techniques.

The classification process is taken input as the extracted feature maps to the fully connected layer. The features are analyzed then final output of classification is got from SoftMax layer of DCNN. The detection procedure is basically in conformance with DCNN, but before the fully connected layer, a convolution layer is added to reduce the dimension of the features.

$$L_{total} = \begin{cases} L_{object} + \beta \cdot L_{background} (if\ O_{ratio} = True\ and\ B_{ratio} = True) \\ \beta \cdot L_{background}\ (if\ O_{ratio} = False\ and\ B_{ratio} = True) \\ L_{object}\ (if\ O_{ratio} = True\ and\ B_{ratio} = False) \end{cases}$$

RESULT

This project belonging to region proposal based and regression/classification-based frameworks were utilized for the construction of detection model taking input of images containing multiple marine lives and outputting them with precise bounding boxes. After classification process, get the results as marine animal detection. The proposed neural network model gives the better accuracy of classification marine species. The outcome of proposed system is get the marine species names based on the tested image from the dataset.

CONCLUSION

By transposing the problem of detect marine animal from an industrial. The produced detection can either be used to speed up the object discovery for new underground sea and animal population density estimation. By leveraging pre-trained convolutional neural network features without full annotations, the proposed approach is able to detect marine animals. Although not yet on par with supervised methods, this is a first step on enabling weakly supervised detection of marine animals. During the work, one of our observations is that the training set should contain normal samples with good quality, since most anomaly detection methods, including ours, are often sensible to the contamination of the training set with anomalous images. Despite its great potential in marine animal from aerial images, the proposed method cannot classify between different species.

FUTURE ENHANCEMENT

Future work on unsupervised clustering of proposals could result in improving precision by detecting irrelevant proposal beyond providing some solutions for the unsupervised classification task. The real time video recordings are used to detect marine animals using efficient object detection methods.

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