FORM 2

THE PATENTS ACT, 1970

(39 of 1970)

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THE PATENTS RULES, 2003

PROVISIONAL/COMPLETE SPECIFICATION

(See section 10 and rule 13)

- **TITLE OF THE INVENTION: An Analytical Approach for Cetacean Family Species Detection using Auditory CNN Multi-class Classification**

APPLICANT(S)

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- **PREAMBLE TO THE DESCRIPTION**

PROVISIONAL	**COMPLETE**

1. **DESCRIPTION**

TECHNICAL FIELD OF INVENTION

The current proposal focuses on classifying and detecting the species of the cetacean family using auditory CNN or Other hybrid algorithms like RCNN.

BACKGROUND AND PROBLEM WITH EXISTING ART

Bioacoustics is the study which focuses on studying the production, transmission and reception and other features of the animal sound. This field of study helps us to understand and analyze more about animals.

The taxonomic group known as Cetacea includes the family of aquatic animals known as Cetaceans. Cetaceans with baleen plates (thin, comb-like plates comprised of a substance called baleen) and cetaceans with teeth, also known as Mysticeti and Odontoceti, respectively, can be further subdivided into two categories.

This family comprises all species of whales, dolphins and porpoises, which exhibits a broad range of sophisticated social structures, social behaviors and intricate communication patterns. This results in them being an object of research for over a decade with the intention to understand their structures, behaviors and patterns.

As the cetaceans emit a variety of sounds, each with a unique call characteristic and function, we primarily focus on their vocalizations in this present proposal.

The intelligent bottlenose dolphin exhibits a variety of vocalizations, such as whistles, clicks, and burst-pulse noises.

Extensive studies have explored communications and social functions of their vocal repertoire. Understanding their vocalizations contributes to our knowledge of their intricate social behavior and echolocation capabilities.

Humpback whales exhibit a remarkable repertoire of complex and diverse songs, featuring repeated patterns of sounds. These songs are known for their extended duration and the transmission range and variations within populations. The research conducted on humpback whale vocalizations has shed light on their communication patterns and cultural dynamics.

Killer whales, also known as orcas, have a wide range of vocalizations that change between populations and social groupings. Whistles, clicks, and calls are among their vocalizations, and they are essential for their social coordination and communication within their highly developed social structure. Killer whale vocalizations are complicated, and researchers have worked hard to understand how they affect social dynamics.

The distinctive clicking vocalization known as "click trains" is used by sperm whales, who are famous for their enormous size. Within their social groupings, these clicks are thought to be used for echolocation and communication. Insights on sperm whale behavior, ecological interactions, and population dynamics have been gained from research on their vocalizations.

Beluga whales, recognised for their distinct white coloration, emit a diverse array of vocalizations such as whistles, clicks, chirps, and squawks. Investigations into their vocal communication have revealed intriguing details about their social interactions, navigational abilities, and overall behavior.

With an increasing risk for the marine ecosystem and cetacean family, also known as the marine mammals, the current utility patent proposes an analytical approach for detecting and classifying cetacean species which could further help people trying to study or rescue the marine mammals.

Because of the advancements in technology in this field and also because there is a significant threat to the marine ecosystems' health and to the cetacean family , there is a strong passion and scope for research in this particular field.

There are several identification and specification models on which research papers have been published but they all have minor issues like ,Information gained was not sufficient to overcome the network complexity, Not appropriate for larger datasets and if datasets contain a lot of noise, Only 32 species were covered in the entire dataset.

There is thus a need for a model which is trained with almost all the species of the family to improve the accuracy of detecting and classifying the species, and a simpler and more efficient algorithm is also used for the same.

SUMMARY OF THE INVENTION

The proposal pivots on building and training a model to classify and identify the species of the member of the cetacean family (Whales, Dolphins, Porpoises).

This patent would make classifying and detecting the species of the cetacean family easier, so that a layman could understand rather than making it accessible only to marine biologists. This would make it easier for fellow researchers to further study the cetacean family.

The concept operates in a straightforward manner; it develops and trains a model that can identify and categorize the species. It takes raw audio data, performs feature extraction analysis on it, and then uses spectrograms and time-frequency representations to visualize the data.

The model employs machine learning models to categorize the data and deep learning algorithms to learn from it.

The above is a brief summary of the proposal's current invention procedures. This summary does not address the current invention or its applications. It merely simplifies a few key implementation concepts of the current invention as an introduction to the subsequent, more in-depth explanation. As will be seen, alternative implementations of the current invention can make use of one or more of the features included in the proposal.

BRIEF DESCRIPTION OF THE DRAWING

The flowchart shows the flow of data throughout the program and also demonstrates what is happening at what particular stage, which makes it easy for another person to understand how exactly the program works.
It also mentions the models that are to be used at particular stages.

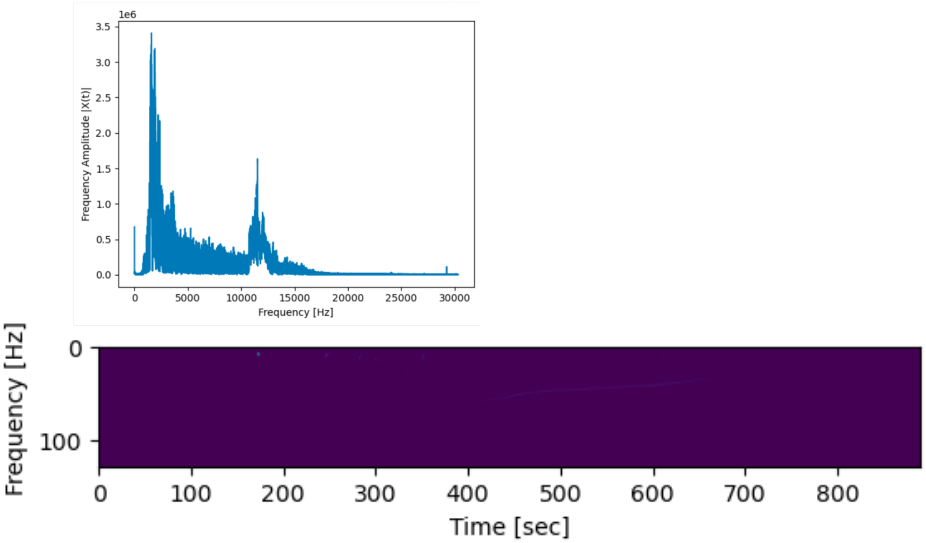
Image.1 shows a schematic representation of the working of the program and briefly describes the functions of each stage.

DETAILED DESCRIPTION

The patent proposes an idea where it can identify and classify the species of the cetacean family members, specifically the marine mammals. This patent makes use of hybrid deep learning algorithms to build a model to learn and machine learning algorithms to classify.

It can be simplified into simple stages of processes, starting with fetching the data. The fetched data has a lot of disturbances, noise etc. Hence the next stage is to process the acquired data. This gives an output of processed data, in this scenario, cleaner audio with lesser disturbances and noise.

This processed data is now visualized to understand the various features of the audio input and is visualized using several tools and libraries. An example of visualizing data for one of the audio input is shown below:



The method of feature extraction involves deleting unnecessary data in order to obtain pertinent information that will improve the detector's and classifier's performance. The characteristics given to a detector or classifier have a key role in how well it performs. Raw data frequently contains extraneous information. The main purpose of the Feature extraction method is to extract from the raw information the necessary characteristics or parameters of the signal of interest. Feature extraction and feature selection may be used for the reduction.

The various possible methods to extract features are :

A. SHORT TIME FOURIER TRANSFORM (STFT) - The STFT employs a sliding window to obtain a spectrogram which provides information of both time and frequency of a signal

B. WAVELET TRANSFORM (WT) - The wavelet transform technique (WT) is perfect in describing features of non-stationary signals.

C. HILBERT HUANG TRANSFORM (HHT)

Compared to more traditional time-frequency analysis techniques like STFT and WT, it produces a better result. The procedure is applied in two steps and is fully empirical.

D. EMPIRICAL MODE DECOMPOSITION (EMD)

Speech signals are quickly represented as short-time spectral information by LPCs. This method's key idea is that it uses a linear combination of prior samples to predict the value of the current sample signal Y (n), and that it then estimates the difference between the actual value and the projected value.

E. LINEAR PREDICTION COEFFICIENTS (LPCs) -

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sample signal Y (n), and that it then estimates the difference between the actual value and the projected value.

F. MEL-SCALE FREQUENCY CEPSTRAL COEFFICIENTS (MFCCs)-

To create a feature vector set for each type of signal, features are extracted in the cepstral domain. Because of how simple its computations are, MFCC is often used;it is however sensitive to noise due to its dependence on spectral form. Features are extracted by transforming signals from the time domain into the frequency domain (mel frequency scale).

Once the features are extracted , it is converted into a feature array and this is then further passed onto the next stage where the model classifies and learns how to detect and identify the species.

5. CLAIMS

I/We Claim

1. An Analytical Approach for Cetacean Family Species Detection using Auditory CNN Multiclass Classification

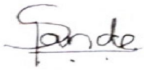
2. Getting improved precision and accuracy with the use of hybrid algorithms such as CRNNs and GANs

3. A dataset which contains audios of approximately 82 different species to train and test the algorithms stated in Claim 2

6. DATE AND SIGNATURE

Date: 11-06-2023

- **Signature(s)**
- **Name(s): Sai Eeshwar D** **Dr.Sagar Dhanraj Pande**
- **Signature(s):**



- **Name(s):**

Signature(s)

1. **ABSTRACT OF THE INVENTION**:

Bioacoustics is a multidisciplinary field of science in which we focus on studying the sounds of living organisms, which includes animals, plants and even microbes to a certain extent. It involves the assessment and explanation of biological sounds, majorly focusing on the sounds produced by animals in their natural environments.

The current utility patent proposes an analytical approach for detecting and classifying cetacean species within the family using auditory data and a multi class classification system based Convolutional Neural Networks (CNNs) and hybrid algorithms such as RCNNs, Cetaceans (Whales, Dolphins, Porpoises) have unique vocalizations, which is why their audio data is a very valuable resource for species identification.

The above approach combines advancements in deep learning, bioacoustics and machine learning to provide an accurate and efficient output in detecting the species.