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MONITORING THE MOVEMENTS OF WILD ANIMALS AND ALERT SYSTEM USING DEEP LEARNING ALGORITHM

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Abstract

Efficient and reliable monitoring of wild animals in their natural habitat is essential. This project develops an algorithm to detect the animals in wild life. Since there are large number of different animals manually identifying them can be a difficult task. This algorithm classifies animals based on their images so we can monitor them more efficiently. Animal detection and classification can help to prevent animal-vehicle accidents, trace animals and prevent theft. This can be achieved by applying effective deep learning algorithms.

Introduction

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use it learn for themselves.The process of learning begins with observations or data, such as examples, direct experience, or instruction, in order to look for patterns in data and make better decisions in the future based on the examples that we provide. The primary aim is to allow the computers learn automatically without human intervention or assistance and adjust actions accordingly. Deep learning is a subset of machine learning. Deep artificial neural networks are a set of algorithms that have set new records in accuracy for many important problems, such as image recognition, sound recognition, etc., In deep learning, a convolutional neural network (CNN) is a class of deep neural networks, most commonly applied to analyzing visual imagery.CNNs use relatively little pre-processing compared to other image classification algorithms. This means that the network learns the filters that in traditional algorithms were hand-engineered. This independence from prior knowledge and human effort in feature design is a major

advantage. They have applications in image and video recognition, recommender systems, image classification, medical image analysis, and natural language processing. One of the applications of the deep learning technique called Convolutional Neural Network is animal detection. Observing wild animals in their natural environments is a central task in ecology. The fast growth of human population and the endless pursuit of economic development are making over-exploitation of natural resources, causing rapid, novel and substantial changes to Earth's ecosystems. An increasing area of land surface has been transformed by human action, altering wildlife population, habitat and behaviour. More seriously, many wild species on Earth have been driven to extinction, and many species are introduced into new areas where they can disrupt both natural and human systems. Monitoring wild animals, therefore, is essential as it provides researchers evidences to inform conservation and management decisions to maintain diverse, balanced and sustainable ecosystems in the face of those changes.

Literature survey

Xie, Z., A. Singh, J. Uang, K.S. Narayan and P.Abbeel. Multimodal blending for high-accuracy Instance cognition. In: 2013 IEEE/RSJ International Conference on Intelligent Robots and Systems. Tokyo: IEEE 2013, pp. 2214-2221. ISBN 978-1-4673-6356-3. DOI: 10.1109/IROS.2013.

Efficient and reliable monitoring of wild animals in their natural habitat is essential. This project develops an algorithm to detect the animals in wild life. Since there are large number of different animals manually identifying them can be a difficult task. This algorithm classifies animals based on their images so we can monitor them more efficiently. Animal detection and classification can help to prevent animal-vehicle accidents, trace animals and prevent theft. This can be achieved by applying effective deep learning algorithms. Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed.

Tiber Trnovszky, Patrik Kamencay, Richard Orjesek, Miroslav Benco, Peter Sykora. Animal recognition system based on convolutional neural network.

In this paper, the Convolutional Neural Network (CNN) for the classification of the input animal images is proposed. This method is compared with well-known image recognition methods such as Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), Local Binary Patterns Histograms (LBPH) and Support Vector Machine (SVM). The main goal is to compare the overall recognition accuracy of the PCA, LDA, LBPH and SVM with proposed CNN method. For the experiments, the database of wild animals is created. This database consists of 500 different subjects (5 classes / 100 images for each class). The overall performances were obtained using different number of training images and test images. The experimental results show that the proposed method has a positive effect on overall animal recognition performance and outperforms other examined methods. Currently, the animal detection and recognition are still a difficult challenge and there is no unique method that provides a robust and efficient solution to all situations. Generally, the animal detection algorithms implement animal detection as a binary pattern classification task [1].

Ahonen, T., Hadid, A., Pietikainen, and M.: Face description with local binary patterns:Application to face recognition. IEEE TPAMI 28(12), 2037-2041 (2006).

In this work, we present a novel approach to face recognition which considers both shape and texture information to represent face images. The face area is first divided into small regions from which Local Binary Pattern (LBP) histograms are extracted and concatenated into a single, spatially enhanced feature histogram efficiently representing the face image. The recognition is performed using a nearest neighbour classifier in the computed feature space with Chi square as a dissimilarity measure. Extensive experiments clearly show the superiority of the proposed scheme over all considered methods (PCA, Bayesian Intra/extrapersonal Classifier and Elastic Bunch Graph Matching) on FERET tests which include testing the robustness of the method against different facial expressions, lighting and aging of the subjects. In addition to its efficiency, the simplicity of the proposed method allows for very fast feature extraction. The availability of numerous commercial face recognition

systems [1] attests to the significant progress achieved in the research field [2].

Burghardt, T., Calic, J.: Real-time face detection and tracking of animals. In:Neural Network Applications in Electrical Engineering. pp. 27{32. IEEE (2006).

This paper presents a real-time method for extracting information about the locomotive activity of animals in wildlife videos by detecting and tracking the animals' faces. As an example application, the system is trained on lions. The underlying detection strategy is based on the concepts used in the Viola-Jones detector [1], an algorithm that was originally used for human face detection utilising Haar-like features and AdaBoost classifiers. Smooth and accurate tracking is achieved by integrating the detection algorithm with a low-level feature tracker. A specific coherence model that dynamically estimates the likelihood of the actual presence of an animal based on temporal confidence accumulation is employed to ensure a reliable and temporally continuous detection/tracking capability. The information generated by the tracker can be used to automatically classify and annotate basic locomotive behaviours in wildlife video repositories. The problem of semantic annotation in such a complex domain as wildlife video has highlighted the importance of efficient and reliable algorithms for animal detection and tracking. Not only to recognise the presence of an animal and determine its species but to narrow the contextual space of wildlife's heterogeneous semantics. However, there have been only a few attempts to solve this problem, mainly focused at a particular and narrow domain rather than offering a more general solution.

Felzenszwalb, P.F., Girshick, R.B., McAllester, D., Ramanan, D.: Object detection with discriminatively trained partbased models. IEEE TPAMI 32(9), 1627-1645(2010).

We describe an object detection system based on mixtures of multiscale deformable part models. Our system is able to represent highly variable object classes and achieves state-of-the-art results in the PASCAL object detection challenges. While deformable part models have become quite popular, their value had not been demonstrated on difficult benchmarks such

as the PASCAL datasets. Our system relies on new methods for discriminative training with partially labeled data. We combine a marginsensitive approach for data-mining hard negative examples with a formalism we call latent SVM. A latent SVM is a reformulation of MI-SVM in terms of latent variables. A latent SVM is semi-convex and the training problem becomes convex once latent information is specified for the positive examples. This leads to an iterative training algorithm that alternates between fixing latent values for positive examples and optimizing the latent SVM objective function. Object recognition is one of the fundamental challenges in computer vision. In this paper we consider the problem of detecting and localizing generic objects from categories such as people or cars in static images

Existing system

The existing system for monitoring the movements of wild animals and implementing an alert system typically relies on a combination of traditional tracking methods and technological solutions. These methods often involve the use of radio collars, GPS trackers, camera traps, and other sensor technologies to collect data on animal movements. While these technologies provide valuable insights, they may have limitations in terms of real-time monitoring and immediate response to potential threats.

In many cases, human intervention is required to analyze the collected data and identify patterns or anomalies in animal behavior. This process can be time-consuming and may not be suitable for scenarios that demand rapid response, such as detecting poaching activities or understanding sudden changes in migration patterns.

To address these limitations, there is a growing interest in integrating deep learning algorithms into the existing monitoring systems. Deep learning, a subset of artificial intelligence, can analyze large datasets and identify complex patterns without explicit programming. By deploying deep learning algorithms on camera trap footage or sensor data, the system can automatically recognize and classify animal movements, behaviors, and even potential threats.

The alert system, in this context, could be designed to trigger notifications or alerts in real-time when the algorithm identifies unusual behavior, such as unauthorized human presence or deviations from typical migration routes. This integration of deep learning algorithms enhances the efficiency of wildlife monitoring efforts, providing a more proactive approach to conservation and wildlife management. However, challenges such as data privacy, ethical considerations, and the need for continuous

model training should be carefully addressed in the implementation of such systems. Overall, the incorporation of deep learning algorithms into existing wildlife monitoring systems represents a promising avenue for advancing the field of conservation and ensuring the protection of wild animals in their natural habitats.

Proposed system

The monitoring of wild animal movements and the alert system, powered by deep learning algorithms, constitutes an advanced approach to wildlife conservation and management. In the existing system, a network of cameras and sensors is strategically placed in natural habitats to capture and record the movements of wild animals. These devices are often equipped with advanced imaging capabilities and environmental sensors to gather a comprehensive dataset. The data collected is then processed using deep learning algorithms, which excel at pattern recognition and classification.

Deep learning algorithms, particularly convolutional neural networks (CNNs) in the context of image analysis, play a crucial role in identifying and tracking wildlife. These algorithms can differentiate between various species, recognize individual animals, and monitor behavioral patterns. The integration of artificial intelligence enables the system to process vast amounts of data quickly, providing real-time insights into the dynamics of wildlife populations.

The alert system is a key component of this setup. When unusual behavior or potential threats are detected, the deep learning algorithm triggers alerts to wildlife conservationists, researchers, or park rangers. These alerts can be delivered through various channels such as mobile applications, emails, or centralized monitoring systems. Timely notifications empower conservationists to respond promptly to emerging situations, whether they involve poaching activities, habitat disturbances, or unusual animal behavior.

Furthermore, the deep learning model can continuously evolve and improve its accuracy over time as it learns from new data. This adaptability ensures that the system becomes increasingly adept at distinguishing between normal and abnormal behaviors, reducing false positives and enhancing the overall effectiveness of wildlife monitoring efforts.

In conclusion, the integration of a deep learning algorithm into the monitoring of wild animal movements, coupled with an alert system, represents a significant advancement in wildlife conservation. This technology not only provides valuable insights into the behavior of diverse species but also enables proactive conservation measures, ultimately contributing to the protection of biodiversity and the preservation of natural ecosystems.

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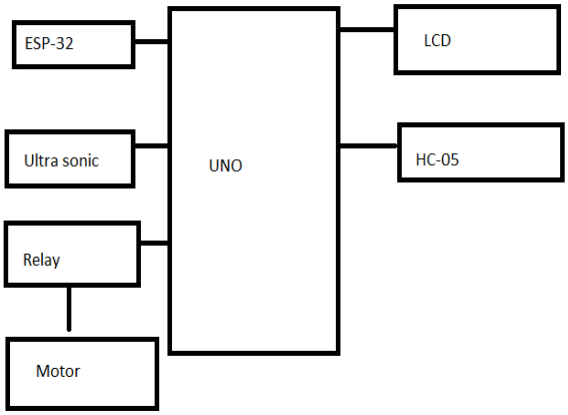
Block diagram



HARDWARE COMPONENTS

LCD (Liquid Cristal Display)

Introduction:

A liquid crystal display (LCD) is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. Each pixel consists of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters, the axes of polarity of which are perpendicular to each other. Without the liquid crystals between them, light passing through one would be blocked by the other. The liquid crystal twists the polarization of light entering one filter to allow it to pass through the other.

A program must interact with the outside world using input and output devices that communicate directly with a human being. One of the most common devices attached to an controller is an LCD display. Some of the most common LCDs connected to the contollers are 16X1, 16x2 and 20x2 displays. This means 16 characters per line by 1 line 16 characters per line by 2 lines and 20 characters per line by 2 lines, respectively.

ULTRA SONIC SENSOR:

This "ECHO" Ultrasonic Distance Sensor from Rhydolabz is an amazing product that provides very short (2CM) to long-range (4M) detection and ranging. The sensor provides precise, stable non- contact distance measurements from 2cm to 4 meters with very high accuracy. Its compact size, higher range and easy usability make it a handy sensor for distance measurement and mapping. The board can easily be interfaced to microcontrollers where the triggering and measurement can be done using one I/O pin. The sensor transmits an ultrasonic wave and produces an output

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pulse that corresponds to the time required for the burst echo to return to the sensor. By measuring the echo pulse width, the distance to target can easily be calculated.

ECHO SENSOR FEATURES

- Professional EMI/RFI Complaint PCB Layout Design for Noise Reduction
- Range : 2 cm to 4 m
- Accurate and Stable range data
- Data loss in Error zone eliminated
- Modulation at 40 KHz
- Mounting holes provided on the circuit board
- Triggered externally by supplying a pulse to the signal pin
- 5V DC Supply voltage
- Current - < 20Ma
- Bidirectional TTL pulse interface on a single I/O pin can communicate with 5 V TTL or 3.3V CMOS microcontrollers
- Echo pulse: positive TTL pulse, 87 ^s minimum to 30 ms maximum(PWM)
- On Board Burst LED Indicator shows measurement in progress
- 3-pin header makes it easy to connect using a servo extension cable, no soldering required

PIN DEFINITION

PIN	PIN NAME	DETALES
VCC	Power Supply	Power Supply Input (+5V)
GND	Ground	Ground Level of Power supply
SIGNAL	Signal I/O	This pin reads the trigger pulse from the host microcontroller and returns the pulse based on the distance.

RELAY MODULE

Relay modules are simply circuit boards that house one or more relays. They come in a variety of shapes and sizes, but are most commonly rectangular with 2, 4, or 8 relays mounted on them, sometimes even up to a 16 relays.

Relay modules contain other components than the relay unit. These include indicator LEDs, protection diodes, transistors, resistors, and other parts. But what is the module relay, which makes the bulk of the device? You may ask. Here are facts to note about it:

- A relay is an electrical switch that can be used to control devices and

systems that use higher voltages. In the case of module relay, the mechanism is typically an electromagnet.

- The relay module input voltage is usually DC. However, the electrical load that a relay will control can be either AC or DC, but essentially within the limit levels that the relay is designed for.
- A relay module is available in an array of input voltage ratings: It can be a 3.2V or 5V relay module for low power switching, or it can be a 12 or 24V relay module for heavy-duty systems.
- The relay module information is normally printed on the surface of the device for ready reference. This includes the input voltage rating, switch voltage, and current limit.

Relay Module Function

What does a relay module do? The relay module function is mainly to switch electrical devices and systems on or off. It also serves to isolate the control circuit from the device or system being controlled.

This is important because it allows you the use a microcontroller or other low-power device to control devices with much higher voltages and currents.

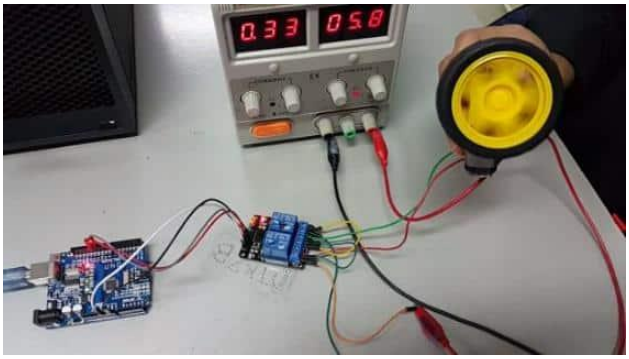
Another relay module purpose is to amplify the control signal so that it can switch the higher currents using only a small out of power from a microcontroller.

Relay Module vs. Relay

It is also important to note the difference between a relay vs. relay module. A relay is a single device that has an electromagnet and a switch, or it can be the solid-state type.

A relay module, on the other hand, is a board that has one or multiple relays on it and several other components to provide isolation and protection.

Because of its modular construction, this type of switching and control device can be many different configurations. It can be a single-channel relay module for a single load or it can be a multi-channel device with multiple relays to control several circuits.



Relay motor working demonstrated Resource: https://www.youtube.com/watch?v=OzlJ9E2_aSo

Conclusion

Thus this project uses Convolutional Neural Network (CNN) algorithm to detect wild animals. The algorithm classifies animals efficiently with a good number of accuracy and also the image of the detected animal is displayed for a better result so that it can be used for other purposes such as detecting wild animals entering into human habitat and to prevent wildlife poaching and even human animal conflict.

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