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Animal Detection And Alert System Using Computer Vision Technique

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ABSTRACT

The integration of computer vision techniques has revolutionized the field of object detection, enabling the development of intelligent systems for various applications. This paper presents an Animal Detection and Alert System leveraging the Speeded-Up Robust Features (SURF) algorithm in computer vision. The proposed system aims to detect and recognize animals in real-time by analyzing video streams or images captured through cameras. The SURF algorithm, known for its robustness to changes in scale, rotation, and illumination, is utilized for feature extraction, enabling the identification of distinctive patterns and keypoints within images. These extracted features serve as the basis for training a machine learning model, facilitating the classification and recognition of different animal species. The system is designed to operate in diverse environmental conditions and is adaptable to various species, accommodating a wide range of animal shapes, sizes, and appearances. Upon successful detection, the system triggers an alert mechanism to notify users or relevant authorities, contributing to the timely and effective management of wildlife crossings, habitat monitoring, or animal presence in restricted areas. This research outlines the methodology employed in dataset collection, preprocessing, feature extraction using SURF, model training, real-time implementation, and alert mechanisms. Furthermore, it addresses the challenges encountered in deploying such systems and proposes avenues for future enhancements, including optimizing performance, expanding the dataset, and exploring alternative algorithms for improved accuracy and efficiency. The proposed Animal Detection and Alert System using omnipotent classifier which demonstrates promising capabilities in enhancing wildlife conservation efforts, minimizing human-wildlife conflicts, and supporting ecosystem monitoring, contributing significantly to the field of computer vision applications in wildlife management and environmental conservation.

Keywords: Speeded-Up Robust Features, Animal Detection, Alert System, Object Detection, Omnipotent Classifier, Scale, Rotation, and Illumination.

1 INTRODUCTION

In the prior days, the forest regions are extremely enormous. Because of deforestation, trees are currently worked as huge structures. As the human population is as yet expanding, woodland zones will be totally crushed. Human-Animal struggle in the general public is for the most part because of lack of nourishment for creatures. Animal aggravation generally happens in the woods fringe regions amongst sunset and first light and it is emphatically regular, comparing

with edit collecting periods [1]. This has been the primary driver for almost 80 human passing and more than 300 elephant passing that have been recorded every year in the current past. Rivalry for space is the essential purpose behind clash amongst people and Animals [2]. Wild animals that escape from the natural life national parks wander into towns making devastation afterward. To counteract such accidents, an appropriate framework is required to contain and screen elephants in national parks. Here we portray diverse ways to deal with identify elephants and conceivable methods for checking the national untamed life parks [3]. The examination, researches and investigations the different location and following methods utilized for before days. Be that as it may, satisfactory and proper technique has not yet grown instead of averting strategy. In this proposed framework, HEC is diminished utilizing the vibration sensor [4]. The vibration sensors are placed on the forest border areas. The arrival of elephant will be detected by sensor and the flag created will be sending to the microcontroller for recognition reason. After the compliance of elephant landing by coordinating procedure the content will be send to the timberland authorities. Taken after by the instant message, the sound is made to alarm the town individuals. Accordingly, our proposed framework will conquer the downsides in the current framework by following and identifying the elephant viably [5].

In our research, Human Animal conflict is major problem in village areas like nilgris, muthumalai, etc. Frequent co-incidence between human and wild animal causes severe damage to farmlands, humans, as well as elephants [6]. The proposed paper is very efficient and effectively reduces the human animal conflict. Camera is used to track the wild animal arrival in forest borders areas. Based on sensor data's, corresponding animal is detected through the camera, it sends information to forest officials and the village members [7]. The animal is matched with unique features of the image, which is stored in the database. The SURF algorithm is used to match the captured image. Immediate alert has to send to nearby village.

2 RELATED WORKS

The aim of our proposed scheme is vission based animal detection system. In this method camera is used to detect the animals arrival in the forest areas to prevent human elephant conflicts. The system deters the elephant while crossing the boundary that it helps to prevent loss of human life and damage of crops. The alarm system to alert people and intimation of elephant arrival to forest officials will be more efficient.

RF sensor networks are wireless networks that can localize and track people (or targets) without needing them to carry or wear any electronic device [8]. They use the change in the received signal strength (RSS) of the links due to the movements of people to infer their locations [9]. In this paper, we consider real-time multiple target tracking with RF sensor networks. We apply radio tomographic imaging (RTI), which generates images of the change in the propagation field, as if they were frames of a video. Our RTI method uses RSS measurements on multiple frequency channels on each link, combining them with a fade level-based weighted average [10]. We introduce methods, inspired by machine vision and adapted to the peculiarities of RTI, that enable accurate and real-time multiple target tracking. Several tests are performed in an open environment, a one-bedroom apartment, and a cluttered office environment. The results demonstrate that the system is capable of accurately tracking in real-time up to four targets in cluttered indoor environments, even when their trajectories intersect multiple times,

without mis-estimating the number of targets found in the monitored area [11]. The highest average tracking error measured in the tests is 0.45 m with two targets, 0.46 m with three targets, and 0.55 m with four targets.

This paper presents a driving simulator experiment, which evaluates a road-departure prevention (RDP) system in an emergency situation. Two levels of automation are evaluated: 1) haptic feedback (HF) where the RDP provides advisory steering torque such that the human and the machine carry out the maneuver cooperatively, and 2) drive by wire (DBW) where the RDP automatically corrects the front-wheels angle, overriding the steering-wheel input provided by the human [12]. Thirty participants are instructed to avoid a pylon-confined area while keeping the vehicle on the road. The results show that HF has a significant impact on the measured steering wheel torque, but no significant effect on steering-wheel angle or vehicle path. DBW prevents road departure and tends to reduce self-reported workload, but leads to inadvertent human-initiated steering resulting in pylon collisions. It is concluded that a low level of automation, in the form of HF, does not prevent road departures in an emergency situation [13]. A high level of automation, on the other hand, is effective in preventing road departures. However, more research may have to be done on the human response while driving with systems that alter the relationship between steering-wheel angle and front-wheels angle.

This paper introduces two main contributions to the wireless sensor network (WSN) society. The first one consists of modeling the relationship between the distances separating sensors and the received signal strength indicators (RSSIs) exchanged by these sensors in an indoor WSN [14]. In this context, two models are determined using a radio-fingerprints database and kernel-based learning methods. The first one is a non-parametric regression model, while the second one is a semi-parametric regression model that combines the well-known log-distance theoretical propagation model with a non-linear fluctuation term. As for the second contribution, it consists of tracking a moving target in the network using the estimated RSSI/distance models [15]. The target's position is estimated by combining acceleration information and the estimated distances separating the target from sensors having known positions, using either the Kalman filter or the particle filter. A fully comprehensive study of the choice of parameters of the proposed distance models and their performances is provided, as well as a study of the performance of the two proposed tracking methods. Comparisons to recently proposed methods are also provided.

3 PROPOSED MODEL

The aim of our proposed scheme is vission based animal detection system. In this method camera is used to detect the animals' arrival in the forest areas to prevent human elephant conflicts. The system deters the elephant while crossing the boundary that it helps to prevent loss of human life and damage of crops. The alarm system to alert people and intimation of elephant arrival to forest officials will be more efficient. In this system camera is used to detect the movement of the wild animal. This camera is placed in the forest border areas. When dangerous arrived in the forest border areas, if it crosses the threshold value the analog input is send to the microcontroller. As per our survey and knowledge, there is no public database of animals under consideration exists in the literature. As our research is focussed on automatic

animal (cow) detection in context to Indian roads and conditions, we didn't get much data (images or videos) of cow needed to build a robust database. Even though a good source for the animal images is the KTH dataset [1] and NEC dataset [2] that included pictures of cow and other animals, some more animal videos and pictures have been clicked (during different weather conditions i.e. morning, afternoon and evening) and some of the images have been collected from the internet for creating a healthy database. Hence, a new animal database is created. It is very much essential to have good database and at the same time the quality of the database directly affects the final performance of the classifier. Already the camera is in the ON state when the signal reaches from microcontroller to camera features start matching with the actual image with stored image. The images are already stored in the database for finding the animal which is entered in the forest border areas. For features matching SURF (speedup robust future) algorithm is used to match the unique features of different animals. The images are stored in the blob in the MySQL. Once animal is detected the emergency response is given to the forest officials through e-mail. To alter the village members the information passed through Zigbee protocol. The biggestissue or the problem indetecting animals compared to pedestrians or other objects is that animals come in various size, shape, pose, color and their behavior is also entirely unpredictable. It is entirely unrealistic to build an omnipotent classifier, which can recognize all kind of animals with a casual pose.

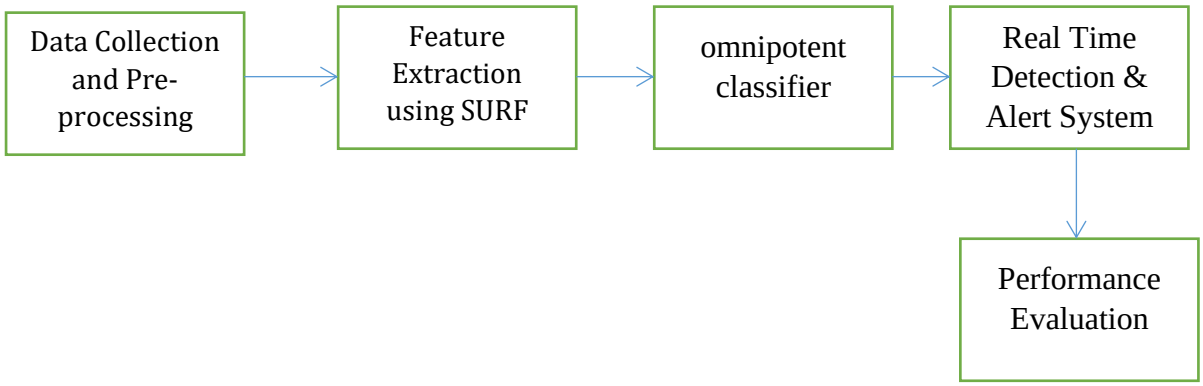

Figure 1: Proposed Architecture

The block diagram consists of two modules as software and hardware module. The process starts with the sensing camera which is to sense the arrival of elephant. when it exceeds then the signal is send to the microcontroller. The analog signal from the microcontroller is send to the PC by serial port communication. The camera is connected to the PC for viewing and capturing the animal image which is then used for matching. The ZigBee transmitter and receiver are used for short distance communication. The LCD display is used to display the elephant name from the database. The buzzer is connected at the receiver side to provide alert signal. The software module consists of MS-visual studio to develop computer programs and surf algorithm for detecting the interest points on image by using blob detector. The surf algorithm is used to locate and recognize the animal and matching its features.

SURF Algorithm

Speeded up robust features (SURF) is a patented local feature detector and descriptor. It can be used for tasks such as object recognition, image registration, classification or 3D reconstruction. It is partly inspired by the scale-invariant feature transform (SIFT) descriptor. The standard version of SURF is several times faster than SIFT and claimed by its authors to be more robust against different image transformations than SIFT. To detect interest points, SURF uses an integer approximation of the determinant of Hessian blob detector, which can be computed with 3 integer operations using a precomputed integral image. Its feature descriptor is based on the sum of the Haar wavelet response around the point of interest. These can also be computed with the aid of the integral image. SURF descriptors have been used to locate and recognize objects, people or faces, to reconstruct 3D scenes, to track objects and to extract points of interest. The image is transformed into coordinates, using the multi-resolution pyramid technique, to copy the original image with Pyramidal Gaussian or Laplacian Pyramid shape to obtain an image with the same size but with reduced bandwidth. This achieves a special blurring effect on the original image, called Scale-Space and ensures that the points of interest are scale invariant.

SURF uses square-shaped filters as an approximation of Gaussian smoothing. (The SIFT approach uses cascaded filters to detect scale-invariant characteristic points, where the difference of Gaussians (DoG) is calculated on rescaled images progressively.) Filtering the image with a square is much faster if the integral image is used. The sum of the original image within a rectangle can be evaluated quickly using the integral image, requiring evaluations at the rectangle's four corners. SURF uses a blob detector based on the Hessian matrix to find points of interest. The determinant of the Hessian matrix is used as a measure of local change around the point and points are chosen where this determinant is maximal. The box filter of size 9×9 is an approximation of a Gaussian with $\sigma=1.2$ and represents the lowest level (highest spatial resolution) for blob-response maps.

The feature finding process is usually composed of 2 steps. The first step is to find the interest points in the image which might contain meaningful structures; this is usually done by comparing the Difference of Gaussian (DoG) in each location in the image under different scales. A major orientation is also calculated when a point is considered a feature point. The second step is to construct the scale invariant descriptor on each interest point found in the previous step. To achieve rotation invariant, we align a rectangle to the major orientation. The size of the rectangle is proportional to the scale where the interest point is detected. The rectangle is then cropped into a 4 by 4 grid.

4 EXPERIMENTAL RESULTS

When an elephant arrive in forest border areas, vibration sensor gets the signal and the elephant is detected. The features of the elephant are mapped with the existing data in the database. If the two features match, an alarm gets ON with an instant e-mail to the forest officials and the village people are alerted with the help of an LCD display regarding the elephant‟s arrival.

Figure 2: Features mapping

The above figure shows that features mapping of the animals using SURF algorithm. The image which is stored in the database is matched with image which is present in the camera.

[{"id":1,"detected":"image","name":"elephant","datetime":"2018-03-07T11:49:15","remarks":"none"},{"id":2,"detected":"image","name":"elephant","datetime":"2018-03-07T11:49:37","remarks":"none"},{"id":3,"detected":"image","name":"elephant","datetime":"2018-03-09T09:28:21","remarks":"none"},
{"id":4,"detected":"image","name":"elephant","datetime":"2018-03-09T09:29:17","remarks":"none"},{"id":5,"detected":"image","name":"elephant","datetime":"2018-03-09T09:30:54","remarks":"none"},{"id":6,"detected":"image","name":"elephant","datetime":"2018-03-09T09:31:18","remarks":"none"},
{"id":7,"detected":"image","name":"elephant","datetime":"2018-03-09T09:32:11","remarks":"none"},{"id":8,"detected":"image","name":"elephant","datetime":"2018-03-10T10:07:14","remarks":"none"},{"id":9,"detected":"image","name":"elephant","datetime":"2018-03-10T10:35:29","remarks":"none"},
{"id":10,"detected":"image","name":"elephant","datetime":"2018-03-10T12:10:09","remarks":"none"},{"id":11,"detected":"image","name":"elephant","datetime":"2018-03-10T02:06:18","remarks":"none"},{"id":12,"detected":"image","name":"elephant","datetime":"2018-03-10T02:06:50","remarks":"none"},
{"id":13,"detected":"image","name":"elephant","datetime":"2018-03-10T02:07:10","remarks":"none"},{"id":14,"detected":"image","name":"elephant","datetime":"2018-03-10T02:07:25","remarks":"none"},{"id":15,"detected":"image","name":"elephant","datetime":"2018-03-10T02:07:45","remarks":"none"},
{"id":16,"detected":"image","name":"elephant","datetime":"2018-03-10T02:07:55","remarks":"none"},{"id":17,"detected":"image","name":"elephant","datetime":"2018-03-10T02:08:08","remarks":"none"},{"id":18,"detected":"image","name":"elephant","datetime":"2018-03-10T02:44:19","remarks":"none"},
{"id":19,"detected":"image","name":"elephant","datetime":"2018-03-15T03:34:24","remarks":"none"},{"id":20,"detected":"image","name":"elephant","datetime":"2018-03-15T03:38:30","remarks":"none"},{"id":21,"detected":"image","name":"elephant","datetime":"2018-03-16T06:42:05","remarks":"none"}]

Figure 3: Application Programming Interface

The above figure shows the overall experimental setup of the human elephant conflict using the vibration of the elephant. The detection is carried by the vibration sensor and the features matching is done and emergency response given to forest officials and the village members.

5 CONCLUSION

In this paper, we focus on wildlife monitoring and analysis through animal detection from natural scenes acquired by camera-trap networks. The image sequences obtained from camera-trap consist of highly cluttered images that hinder the detection of animal resulting in low-detection rates and high false discovery rates. To handle this problem, we have used a camera-trap database that has candidate animal proposals using multilevel graph cut in the spatio-temporal domain. These proposals are used to create a verification phase that identifies whether a given patch is animal or background. Human Animal conflict is major problem in village areas like nilgris, muthumalai, etc. Frequent co-incidence between human and wild animal causes severe damage to farmlands, humans, as well as elephants. The proposed paper is very efficient and effectively reduces the human animal conflict. Camera is used to track the wild animal arrival in forest borders areas. Based on sensor data's, corresponding animal is detected through the camera, it sends information to forest officials and the village members. The animal is matched with unique features of the image, which is stored in the database. The SURF algorithm is used to match the captured image. Immediate alert has to send to nearby village.

In future, the automatic sound amplification device can be designed to create panic to the elephant through huge noise. This will avoid Human Elephant Conflict in forest border area.

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