Animal and Pedestrian Detection System for Automated Vehicle

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Abstract:- Detection of animals and pedestrians on the roads using advanced systems such as robots or vehicles is not an easy task. We can overcome this by using conventional tools and high end sensors such as ultrasonic sensors or usage of innovative technology based on smart cameras. In this paper, we will be investigating a vision based solution for the problems faced. We begin the paper understanding few differences between the three major detectors: 1) Haar-AdaBoost; 2) Histogram of oriented gradient (HOG)-AdaBoost and 3) Local Binary pattern (LBP)-AdaBoost. Linear Support Vector Machine (LSVM) which is used in order for a better and reliable classification of human and animal detection. The proposed architecture aims for high detection accuracy and good computation speed.

General Terms:- HOG algorithm AdaBoost algorithm, LBP algorithm, SVM, LSVM.

Keywords:- Automated collision avoidance system, real-time systems, obstacle detection.

1. INTRODUCTION

Nowadays, Animal and collision has been a major problem. Natural Resource Agencies and Surveys of United States have observed 0.5 to 1.5 million deer has been killed on roads yearly. Similar situations are observed in Asia, Africa and Europe. For instance, some European countries spectated more than 507,000 collisions, resulting 300 human accidents and 30,000 humans injured annually. To prevent this the automated collision avoidance system have aimed to adapt drivers in hindrance detection and avoidance.

Automated collision avoidance system is used for safety purpose for roadway users. As the collision of animals need to be detected and avoided, similarly pedestrian's collision detection is also equally important. Because of the very low requirement of the power, the sensors used are concerned of non-imaging sensors mainly acoustic, magnetic, passive infrared, radar, seismic, ultrasonic and E-field. During last decade, many AVC alleviation architectures has been proposed in [2] and [3]. These architectures have been classified into two methods: 1) Passive methods, which restraints the large animals to keep away from roadways and 2) active methods, concerned with animal detection. Passive method deals with the strategies to warn the animals which is shown in [2]. Other earlier and incompetent techniques, have also been used to keep the animals away from the roads some of them are break the beam methods, roadside refractors and animal reflectors. It is shown that the most efficient way to decrease the number of animal and Pedestrian collusion is to detect animals using cameras, rather than depending upon the deterrence strategies because they are the most effective and accurate way to see the surrounding regions. When compared to the deterrence methods the camera based systems failed on the curved-lane since it is focusing only on some of the regions, it ignores the region outside the field of investigation. So in this paper we focus only on the active methods of computer-vision perspective. The vision-based detection systems mainly uses thermographic cameras, visible range cameras, lasers, or radars to detect the animals and pedestrians. These can be installed along roadsides or inside cars. When these devices detect any pedestrian or animal a warning message will be sent to the drivers as a notification from a dashboard system of a car, or by flashing roadside signs.

We have implemented an architecture based on both animal as well as human detection system. In order to train the classifiers we have created animal, pedestrian positive dataset and also negative dataset .In designing this system there were many challenges. The system must be able to detect pedestrians and animals under different illumination and weather conditions. Hence, all such factors have to be considered to build a robust animal and pedestrian collision detection system.

2. RELATED WORK

This section provides the literature survey of the work done in the animal and pedestrian detection field in the past few years. Animal detection has not received a much greater deal of interest from human machine systems community, despite of some existing AVC mitigation architectures. Most of the papers has given a counter measures which are used to prevent collision. To identify animals three main techniques are used in [4]: 1) Histograms of textons; 2) Intensity-normalized patch pixel values; and 3) The scale invariant feature transform (SIFT) descriptor. However, HOG is comparatively considered to be much better and faster than SIFT since SIFT is a local descriptor which only computes the gradient histogram for blocks around specific interest points, whereas HOG is computed for an entire image. Three detectors are compared in [1] based on the processing time and detection accuracy. They are: 1) Histogram of oriented gradient (HOG) - AdaBoost; 2) Local binary pattern (LBP)-AdaBoost; and 3) Haar-AdaBoost. Compared to other detectors Haar-AdaBoost detectors consumes more time and HOG-AdaBoost consumes less time. HOG-AdaBoost performs slightly faster than LBP-AbaBoost but compared to HOG-AdaBoost the LBP-AdaBoost has good detection accuracy. A two stage architecture developed in [1]. In the first stage the negative images are rejected by using LBP-AdaBoost and it yields region of interest which contains only animal. In the second stage the HOG-SVM classifier scan the region of interest and verify whether the there is an animal or not.

In case of human detection, HOG (Histogram Oriented Gradients) features for classification of objects as human or obstacles. Vision based system overcomes the range limitations as observed using proximity sensors. To reduce errors, thermal image analysis can also be used for detection of faces. This will facilitate detection of a human/obstacle in day as well as night time. It also makes it independent of environmental conditions such as dust or foggy weather. The two major steps involved in a pedestrian detection are feature extraction and classification. In 2005, Dalal N Triggs came up with a system using HOG and SVM classifiers and it was a big success; however the HOG algorithm was taking more time for computation [7]. Hence many modifications were made

to this with time to trade-off between faster computation and accuracy of algorithm. Also, many other researchers came up with different feature extraction algorithms as well as more reliable classifiers.

To overcome the pedestrian detection and collision problem, HOG–LBP (Local Binary patterns) algorithm was used in [11], [12] for increased accuracy. These two were computed for more accurate feature extraction, since it uses two different feature extraction methods the computation increased much greatly. Instead of using two different feature set we have opted for an accurate HOG, a system which is highly efficient and is not time consuming. In this paper, an efficient Modified HOG algorithm is proposed and classified using Linear Support Vector Machine (LSVM).The HOG algorithm is implemented so as to get the best feature extraction of pedestrian considering the requirements of high detection accuracy and high speed.

3. DATASET CREATION

Datasets which contains images of large animals and the images of people walking on roads i.e pedestrians are created. Our main interest is given to large animals crossing roads in rural areas and also to the pedestrian walking on rural, city roads and highways. This concentrates on real scenarios which improves the performance. Animal dataset considers different categories of large animals with diverse postures. In the first step in the creation of the dataset , we take into consideration the two main categories of lateral view shapes "head to left" (HTL) and "head to right" (HTR). The justification is these postures are the most frequently encountered shapes on roads. Four different pedestrian motion types are considered: crossing, stopping, starting to walk and bending-in. For nighttime conditions, a small dataset was constructed. Negative dataset will enhance the performance of the detector since it can reduce the set of false positives. The most important point is that the animal and pedestrian images are not included in the negative dataset. Images that contain the objects such as vehicles, traffic sign boards, road, grass, trees, etc., are included in the dataset. These images have different types of lighting and are at different environmental condition.

Fig 1: HTR dataset of animals

Fig 2: HTL dataset of animals

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Fig 3: Pedestrian dataset

Fig 4: Negative dataset

4. PROPOSED ARCHITECTURE

The proposed architecture is designed to detect animals and pedestrians accurately at faster rate. To detect animals we will be using LBP-AdaBoost and HOG-SVM and to detect pedestrians we shall use modified HOG and LSVM classifier. Since HOG is invariable to photometric or geometric transformations we use modified HOG. The proposed architecture in Fig. 5 checks for the pedestrians and the animal in parallel. Initially the input frames will be given to the simple detector LBP-AdaBoost, which has faster procession time and it rejects negative results quickly. The LBP-AdaBioost is applied to the frame to obtain region of interest which may contain animal. This uses a single classifier which is trained by HTL and HTR animal-dataset categories. Then result of LBP-AdaBoost is sent to the preprocessing 1 stage. Pre-processing is done to the result of the LBP-AdaBoost to adapt the size of ROIs to the requirements of the Modified HOG-SVM detectors, because the resized rejgion of interest can also be large, which may take extra processing time. The preprocessed image is given to two sub classifiers which are parallel to each other. Both the sub-classifier uses Modified HOG-SVM since it has an excellent performance in outline detection, and its ability to eliminate false results which may be obtained from LBP-AdaBoost. Both the sub-

classifiers are used to recognize animals of HTL or HTR. It means that they are trained separately by the HTR and HTL datasets. The HOG-SVM classifier will detect whether there is an animal or not.

While the input frames are given to the LBP-AdaBoost, a copy of the input is preprocessed and given to the Modified HOG-LSVM. In the preprocessing 2 stage, the input frame is will be scaled down to 128x64, since we are using 128x64 image format in the pedestrian dataset The resultant image frame will be passed on to the Modified HOG-LSVM classifier. This classifier is trained with by the pedestrian dataset. The Modified HOG-LSVM classifier will detect the pedestrian in the given input frame.
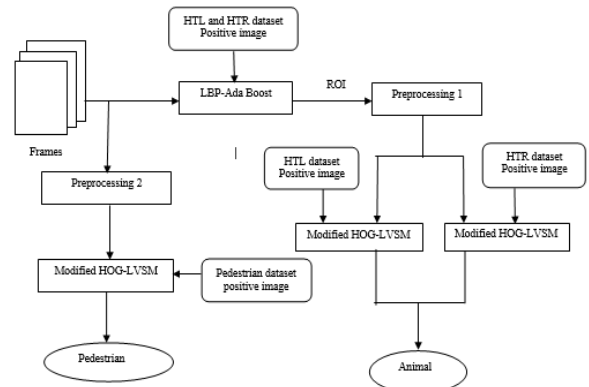

Fig. 5 Architecture design of the animal and pedestrian detection system.

5. NIGHTTIME DETECTION

The most dangerous period for Animal Vehicle Collision and the Pedestrian Vehicle Collision seems to be from 6:00 P.M. to 8:00 A.M. The night period is characterized by weak illumination and a limited field of view, thus creating a different detection environment than that of daytime detection. Usually, a thermographic or infrared camera with a wavelength of 14000 nm is applied to capture objects at night time. Usage of the dataset for animal and pedestrian detection at night is unrealistic. A specific dataset for night-time conditions is to be set. We have taken dataset consisting of thermographic positive images and negative images. The texture features are weak and gradient features can be detected at night. Modified HOG-SVM have the best detection during night-time.
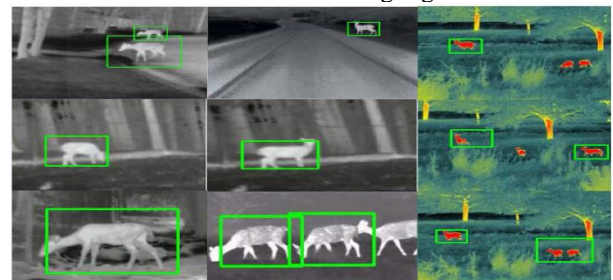

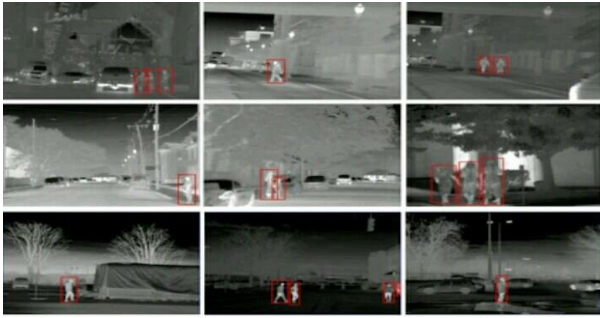Fig. 6 Nighttime experimental results performed on animals.

Fig. 7 Nighttime experimental results performed on pedestrian

6. CONCUSION

The proposed architecture can accurately detect animals and pedestrians with a better computation speed. LBP-AdaBoost, Modified HOG-LSVM classifier were trained with animal and pedestrian positive dataset and negative dataset. Since LBP-AdaBoost has good detection rate we combined it with Modified HOG-LSVM to detect animals and pedestrians. Modified HOG algorithm which is not as complicated as the HOG .It has better computation speed and high accuracy. The proposed architecture can parallelly detect animal and pedestrian. It has good performance in day time and low performance in night time. If the classifiers are trained with a large nighttime dataset, the performance could be better.

7. ACKNOWLEDGMENTS

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