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Automatic Object Detection and Collision Avoidance System using Cascaded Random Classifier

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Abstract: ***One serious problem that all the developed nations are facing today is death and injuries due to road accidents. The collision of an animal with the vehicle on the highway is one such big issue apart from other issues such as vehicle over-speed, abrupt lane change, drunk-drive and others, which leads to such road accidents. In this paper, a simple and a low-cost system for automatic animal detection on highways for preventing animal and object vehicle collision using image processing and computer vision techniques is presented. A method for finding the distance of the animal in real world units by the camera mounted vehicle is also presented. The presented system is trained on more than 2200 images consisting of positive and negatives images and tested on various video clips of animals on highways with varying vehicle speed. As per the two-second rule, our developed system is able to alert the driver when the vehicle speed is up to 35 kmph. Though the developed system has been focused on automatic animal detection in context to Indian highways but it will work in other countries also. The developed system can easily be implemented in any cars and can be extended to detect other animals also after proper training and testing to prevent collision of animals with vehicles on the road.***

I. INTRODUCTION

Highway safety is becoming a major social issue with the number of vehicles increasing day by day, and due to different traffic conditions, crashes can happen with other vehicles, human as well as animals.

There are many ways that the accidents can occur:

1) Misunderstanding or ignoring the marking on the highway.
2) Improper usage of sign.
3) Pass on the signal for moving faster than at a faulty time.
4) Deficiency of knowledge of lane driving in the case of four lanes and six lane highway or freeway.
5) Ignorance o r hidden movement of human and animals.
6) Sudden breaking of the vehicle at the last minute.

Highway accidents are human tragedy. They call for high human suffering and momentary cost in terms of unfortunate deaths, injuries and loss of possible incomes. During the calendar Year 2010, there were close to 5 lakh highway accidents in India, which result in more than 1.3 lakh deaths and causes injuries to 5.2 lakh people. These numbers translated into one road Accidents every minute and one highway accident death every four minutes. Now it is clear that major causes of highway accidents are driver related. So we can develop a system, which help the driver, it can help to reduce the no of accidents and here is the research we are focused on the animal detection system for highway safety and security. Different kinds of animal detection system are found in this paper. They are mainly classified into two categories: on board and road side systems. Roadside system installed at the road borders to detect animals. When an animal is identified, drivers are notified through flashing signs installed at the border on the highway. On the other hand on board systems, which are installed in cars, warn drivers when animals are detected.

II. METHOD FOR ANIMAL DETECTION IN IMAGE PROCESSING IN IMAGE PROCESSING FIELD

Detection system on a highway is broadly classified in two categories as follows:

A. Roadside system

Roadside animal detection systems use sensors to detect large animals, objects or humans that approach the road. When a large animal is detected, the sensors send a message to a warning signal (usually lights mounted on signs) to inform motorists that a large

animal, object and human are now on or near the road. When a driver is aware that large animal as well as any object or human may be on or near the road ahead, the driver may become more alert, may reduce vehicle speed, or both.

The two major types of detection systems are:

1) Area-cover system

Area-cover systems may be active or passive and can detect large animals, objects and humans within a certain range of a sensor. Active systems (i.e., microwave radar) constantly send a signal over an area and measure its reflection. Passive systems (i.e., video detection or passive infrared) detect animals or objects or humans by only receiving signals. These systems require algorithms that tell the difference between different masses (e.g., moving vehicles with warm engines, moving pockets of hot air versus movements of large animals or objects or humans).

2) Break-the-beam system

Break-the-beam systems have transmitters that send infrared, laser or microwave radio signals to a receiver. These receiving sensors detect large animals or object or humans when their bodies physically block or reduce the signal.

a) Pros

i. Detection system does not restrict animals as well as human's movement.

ii. Wildlife high way crossing mitigation measures traffic or driver behavior.

b) Cons

i. The presence of poles and equipments in the right of way is a possible danger to vehicles that run off the road.

ii. Small or medium sized animal as well as object are not detected.

B. Methods for roadside system

1) Animal detection based on GPS Technology [2]: The Global Positioning System is a free service which is a space based satellite direction finding system that provides location and time information, on any place where there is a clear line of sight to four or more satellites.

2) Animal detection based on using rfid, gps, and sensor [5]: An intelligent animal situation tracking service, based on GPS, RFID, and sensors. The proposed system can provide real-time animal situation information such as the current location, body temperature, and picture and it can also track the animals based on the information even when they escape their cages.

3) Gps-based camel vehicle accidents avoidance System [3]: The CVAAS is an animal detection system. This system can provide current location and timely information of animal. The main aim of this system is saving the life of an animal as well as human in such accident. This system consists of three unit animal based unit, animal detection system, and warning unit. This system provides the presence of animal on or near the highway and warns the driver to slow down in order to avoid collision with an animal.

4) Automatic System for Animal Recognition (ASFAR)[6]: The main task of this system is to determine the migration corridors for wild animals in designing area. This system is put in wild nature, often without access to the electricity network and cable internet connection. ASFAR is based on distributed so called "watching device" in designing area and "Main computing unit" acting as server and system manager. Watching device detects the animal and then sends data to MCU to evolution.

5) Fences: Fences have been established to keep animals away from the route. Roadway fencing is the famous conventional techniques used to reduce animal vehicle collision. Fencing is extremely expensive because they have been combined with wildlife crossing structures.

C. On board system

On-board system is installed inside the cars, warn drivers when animals and /or objects are detected. To date, in-vehicle or on-board detectors have typically used infrared technology. Vehicle-mounted sensors detect when a large animal (or human being) is within a certain range of the vehicle, giving the driver time to slow down or stop. Pros:

1) On-board detection do not restrict animal as well as objects movements.

2) The system would not only detect large animals as well as objects, but also humans and pedestrians.

3) The Cost would be distributed amongst individual motorist.

a) Cons

i. Vehicle based systems only inform drivers in those vehicles equipped with such a detection system; drivers in other vehicles will not benefit.

ii. It may take many years, before a substantial percentage of vehicles are equipped with on board detection.

III. METHODS FOR ON BOARD SYSTEM

A. Animal Detection Based On Human Prediction

A human observer is able to take a decision whether a momentarily flashed animal image is having the presence of animal as fast as 150ms.It is good and reliable if the animal detection distance is near and doesn't have a lighting problem**.**

B. Animal Detection Based On Power Spectral

The Power spectrum of the image can be defined as the magnitude of the signal in the frequency domain. Researchers have tried to find whether the presence of the animal in the image scene will change the power spectral of the image or not.

C. Animal Detection Using Face Detection Approach

For locomotive behavior of wild animal, method combining detection and tracking of targeted animal face has been applied in using haar like feature and adaboost classifiers and also use different algorithms.

D. Animal Detection Based On Thresholding Segmentation Method [1]

Target extraction from the background can be performed by using the threshold segmentation method. Threshold segmentation based on image values is performed. The basic idea is that pixel in the image having intensities or values greater than the threshold value is set to white and those pixels having intensities or values less than the threshold value are set to black. It is very difficult and time consuming to select the threshold value as the background image changes periodically.

E. Face Detection Method Using Haar Like Features And Adaboost Classifier [4]

This method detects the animal as well as human faces and warns the driver. It provides the locomotive behavior of animals as well as human. After studying the different on board and road side systems, it is preferred to go to the on board system because roadside system requires the physical infrastructure, insertion of GPS or RFID tag in animals, Animal not having the GPS or RFID tag cannot detect, R RFID or GPS tag is not possible for all animals.

IV. PROPOSED METHOD

The proposed automatic animal detection and collision avoidance system. Referring to figure , a video is taken from a forward facing optical sensor (camera), which is going to capture the objects in front of car, which may have target animal present along with other stationary and non-stationary objects. This video is stored in the computer and then converted into different frames. As the road side video and images are noisy and blurry, we need to perform some preprocessing steps such as noise removal, filtering to enhance the image. Following the same this frames are feed to the Animal detection system. For feature extraction and learning of the system, we are using a combination of Scale invariant local ternary pattern and boosted cascade classifier for animal detection. All the image processing techniques are implemented in MATLAB software. Once the animal gets detected in the video, the next step is to find the distance of the animal from the testing vehicle and then alert the driver so that he can apply the brakes or perform any other necessary action, which is displayed on command prompt as a message. Depending on the distance of the animal from the camera mounted vehicle, three kinds of messages (indication) are given to the driver i.e. animal very near, if animal is very near to the vehicle, animal little far, if the animal is little far from the vehicle and very far, if the animal is very far and at a safe distance from the vehicle**.**

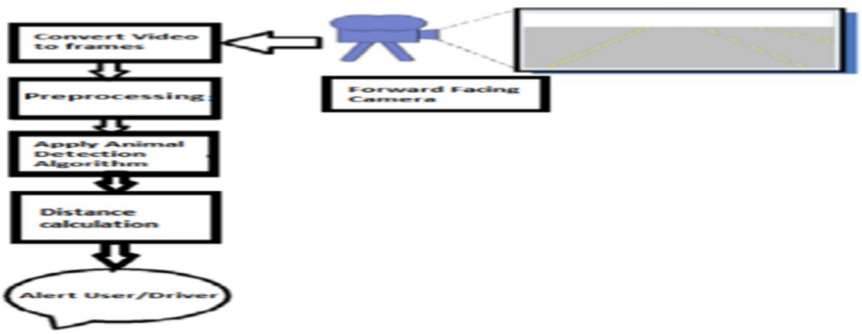

FIGURE 1: Block diagram of automatic animal detection and collision avoidance system

V. CONCLUSION

An efficient automatic animal detection and a warning system can help drivers in reducing the number of collisions occur-ring between the animal and the vehicle on roads and high-ways. In this paper, we discussed the necessity of automatic animal detection system and our algorithm for animal detection based on Scale invariant local ternary pattern and cascade classifier. The algorithm can detect an animal in different conditions on highways. The proposed system achieves an accuracy of almost 82.5 % regarding animal (lion) detection. Estimation of approximate animal distance from the testing vehicle is also done. Though the proposed work has been focused on automatic animal detection in context to Indian highways, it will work in other countries also. The proposed method can easily be extended for detection of other animals too after proper training and testing. The proposed system can be used with other avail-able, efficient pedestrian and vehicle detection systems and can be offered as a complete solution (package) for preventing collisions and loss of human life on highways.

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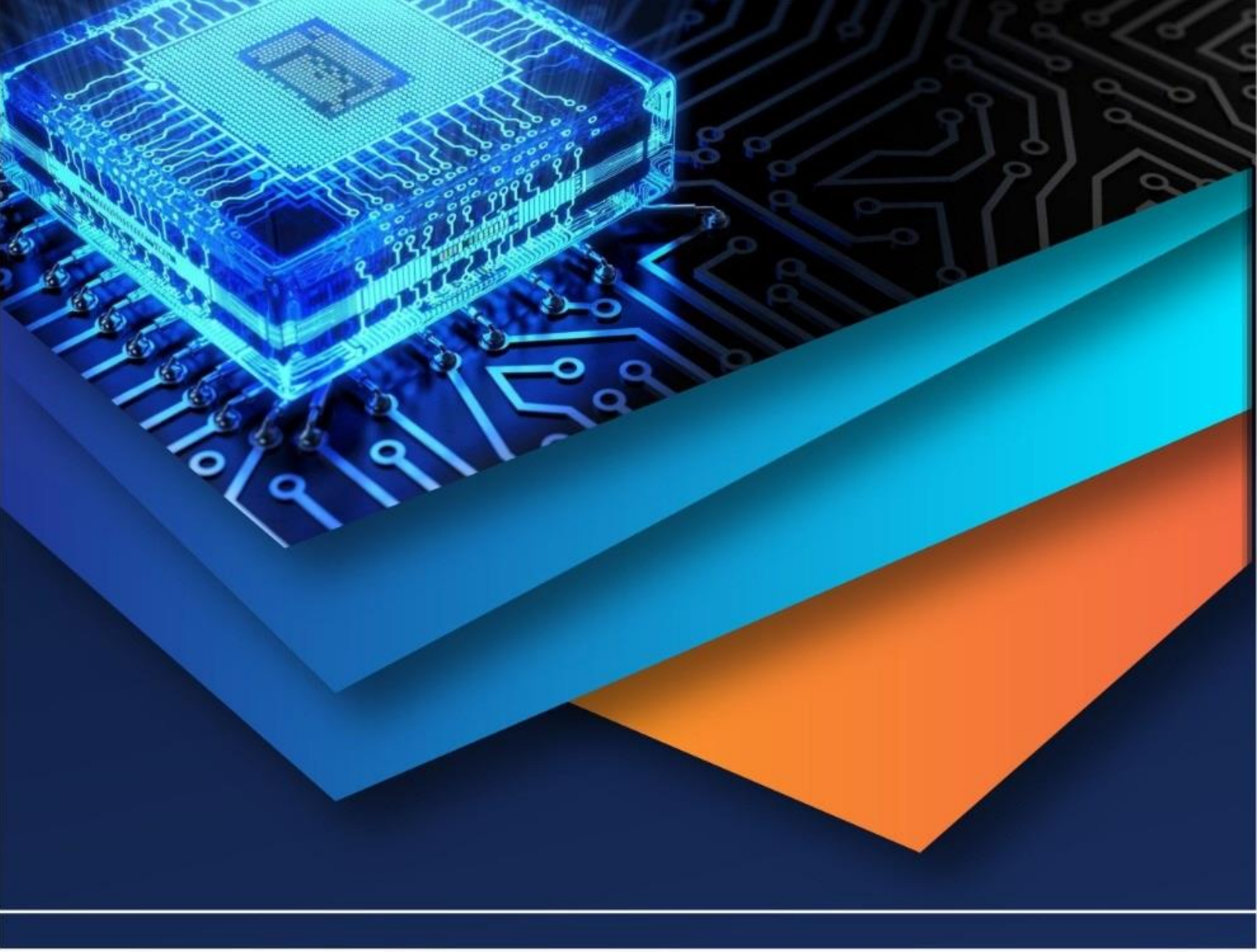

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