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Original Paper

ANIMAL DETECTION USING SSD MODEL WITH RASPBERRY PI FOR VEHICLES

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ABSTRACT

Animal detection is an emerging field of interest now a days. Movement of animals are detected for many purposes. Sometimes animals are detected for saving their lives near highway and railway trucks. Sometimes they are traced on fields and need to drive them away in order to save the crops. This paper is an approach towards detection the animals using mobile net from moving vehicles. Raspberry pi which is suitable for the SSD model has been used here. An alarm has been generated here on the detection of an animal. COCO dataset has been used here for the detection.

KEYWORDS

Object Detection, SSD model, Common Objects in Context (COCO) dataset, Opencv, Raspberry pi, Sensors.

1. INTRODUCTION

Human can easily detect and identify an object from an image or a real time video. But it is very difficult for a machine to identify or detect an object. The process of identifying an object from an image or real time video is called object detection. There are many object detection algorithms available at present. The algorithms popularly used in object detection are YOLO, SSD, RCNN etc. SSD model with COCO can identify 80 objects, but among these objects only the animals are detected in this research work. The main aim of this project is to protect causalities of animals on roads. Animal accident is a severe problem these days. A Raspberry pi with a

camera is mounted on a vehicle which captures real time video. When an animal is detected then an alarm is generated for the driver such that the driver gets alert for nearby animals and takes necessary actions for avoiding accidents.

2. RELATED WORK

To perform object detection in images using a single deep neural network Wie Liu et al worked on a model. They employed SSD, which represents the bounding box output space into predefined default boxes with different aspect ratios and scales at each feature map location. [1]. Elham Mohammed Thabit et al proposed a model for automated mammals' detection using SSD mobile net. In this work they have collected 2000 from the standard dataset(suchasCaltech101) and the net.The detection and recognition processes of Convolution Neural Network (CNN) is improved by the SSD framework [2]. Ashwani Kumar et al develop a model which is composed of multiple layers to classify a given object they have used convolutional neural network(CNN) to develop this model . They improved single shot multi box detector algorithm along with the help of architecture of faster region convolution neural network [3] to enhance the computational performance of object detection. Joseph Redmon et al worked on a new approach on object detection named YOLO. In this method a single neural network predicts bounding boxes and class probabilities directly from full image in one evaluation. The whole detection pipeline is a single network; hence it can be optimized end to end directly on detection performance [4]. Chengcheng Ning et al propose a method Inception SSD(I-SSD) in which they improve the efficiency of the SSD algorithm. Here they adopt an Inception block to replace all the extra layers in SSD [5]. Aswini Kumar et al designed a model to enhance the classification accuracy of the SSD model. In the proposed model they have used multilayers to classify the given objects [6]. Tsung- Yi Lin et al proposed a model which is used to recognize the object [7]. Atri Saxena et al designed a model and this model is developed for animal detection and collision avoidance system utilizing object detection technique. Neural network architecture like SSD and faster R-CNN is considered in the proposed model for detection of animals [8]. Tyden et al designed a model that uses machine learning on the edge device to perform object detection [9]. Peiqin Zhuang et al proposed deep learning model which is used in fish identification and species recognition [10]. K Rancic et al developed three versions of the You Only Look Once (YOLO) architecture and a Single Shot Multi box Detector (SSD) for detecting deer in a dense forest environment [11]. Alsaadi et al designed an animal detection system for detecting birds in images[12]. Aburasain et al proposed a methodology for detecting cattle in farms in desert areas using Deep Neural Networks[13].Balaji VS et al designed a model which incorporates advanced object detection using the Mobile Net SSD model for real-time animal classification[14].R Chandrakar et al proposed a system to detect and recognize the animals automatically using Deep CNN with genetic segmentation[15].Feroz et al used ingle Shot Detector

(SSD) and You Only Look Once (YOLO) models in their research work[16].U Dihingia et al designed a system that is used for detection and classification of animals in real-time by developing a Convolution Neural Network (CNN) [17].SD Meena et al proposed a system that integrates sparse representation utilizing a feature-efficient learning algorithm called Sparse Network of Winnows (SNoW)[18].W Liu et al developed a method to detect objects in images using a single deep neural network[19].E Okafor et al implemented a system with two different deep-learning algorithms to detect object for recognizing different badgers[20].

3. OBJECTIVE

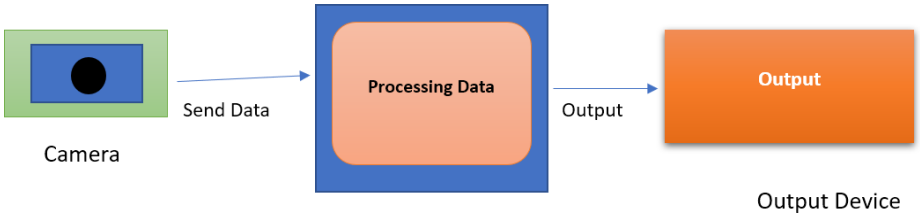

Figure 1: High performance computing device.

In particular, the approach in this paper is development of a device that collects images or videos of animals if they move in an unsafe or sensitive area. Then the image or video data will be sent as input to a high-performance computing power device, then after processing that image or video, an expected output such as an animal entering the sensitive area, if any such output comes, then the signal will appear on a display on the device in this way we can set an alarm. Here a microcontroller is need which will collect output signal from computer and convert into human readable signal such as display, alarm etc.

4. EXISTING SYSTEM AND PROBLEMS

This type of device is already exist but there are some problems such as total systems (input, output and processing) work in same location. A diagram is given here:

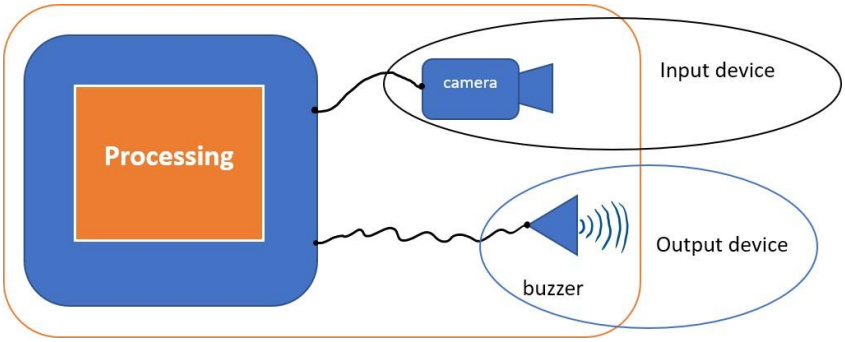

Figure 2: Conceptual diagram of animal detection device

Figure 3: Animal detection device (Existing)[8]

5. MODIFIED DESIGN

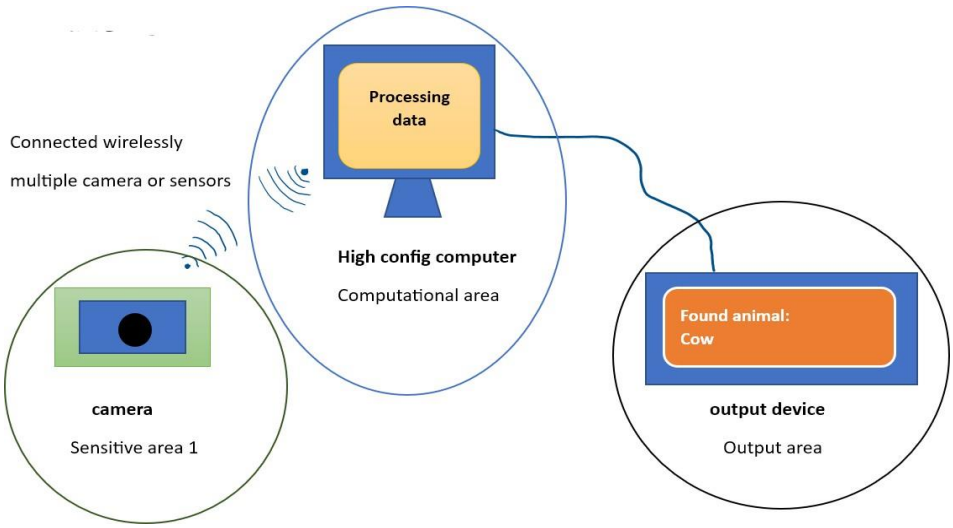

Figure 4: Modified design of animal detection device

This modified design shows that, we have three different parts of whole system.

1. **Sensitive area:** The main area of environments, where we connect all type of sensor as like as camera for collecting video data and it sends to computational area for processing.
2. **Computational area:** Collect data from one or more sensitive are and process it (multiple process can happen simultaneously) for proper output which need to cast to one or multiple output area.
3. **Output area:** This area collects proper output from high config Computational area and convert proper output signal through a microcontroller.

Figure 5: Demo device (image captured from Ip camera) developed.

5.1 Device Description and Our Lab Works

The all-Lab works are executed by two parts:

1. Image Processing.
2. Collecting I/O and implement in Hardware Device.

Some electronic device is important for making this project such as: Ip camera, Microcontroller, Lcd(for showing output) and a high config computer device.

5.2 Flow Diagram of Animal Detection Device

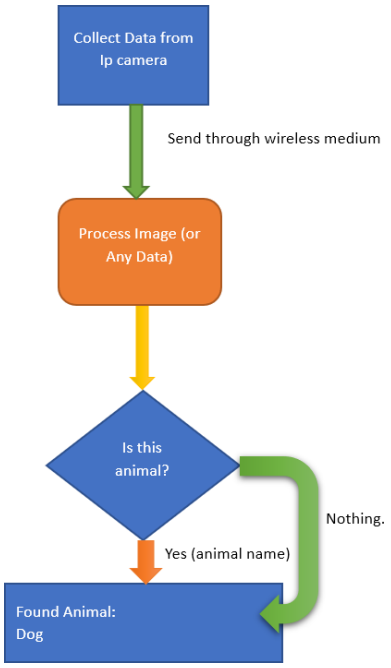

Figure 6: Block diagram of modified device

6.METHODOLOGY

The camera is mounted on the vehicle and it captures real time video of the surroundings. When an animal is detected by the model (SSD) then the model returns a specific numerical value for every detected animal to the raspberry pi. A Red LED (Light Emitting Diode) and 16X2 display is connected with raspberry pi. An alarm for the driver of the vehicle is generated if an animal is identified. Based on the values getting from model (SSD)LCD displays the name of the animal appeared closed to the vehicle. Workflow of the complete process is shown below-

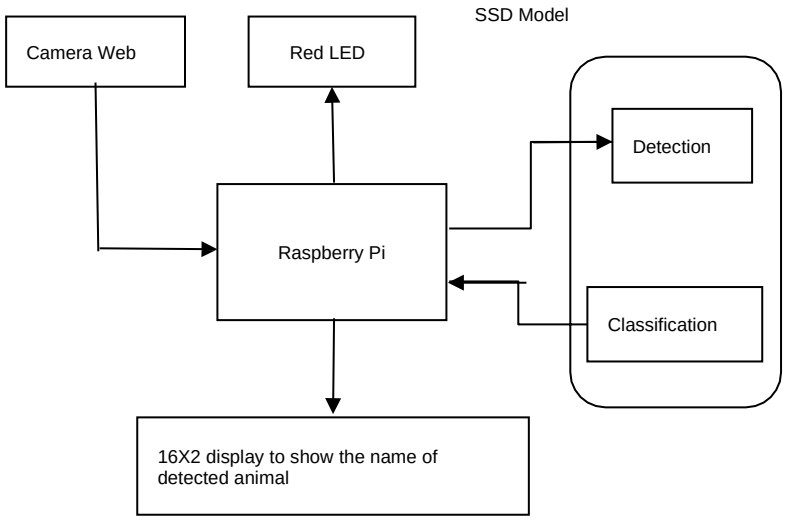

Figure 7: Workflow diagram

The devices like Web camera, LED and 16x2 display are connected to the raspberry pi. Raspberry is a single board CPU which is popularly used in different types of projects.

6.1 THE SINGLE SHOT DETECTOR (SSD) MODEL

The SSD approach uses the feed forward convolutional network which generates a collection of bounding boxes and also put a score for the objects present in the bounding boxes. This is followed by a suppression step which is not maximum, to generate the final detection.

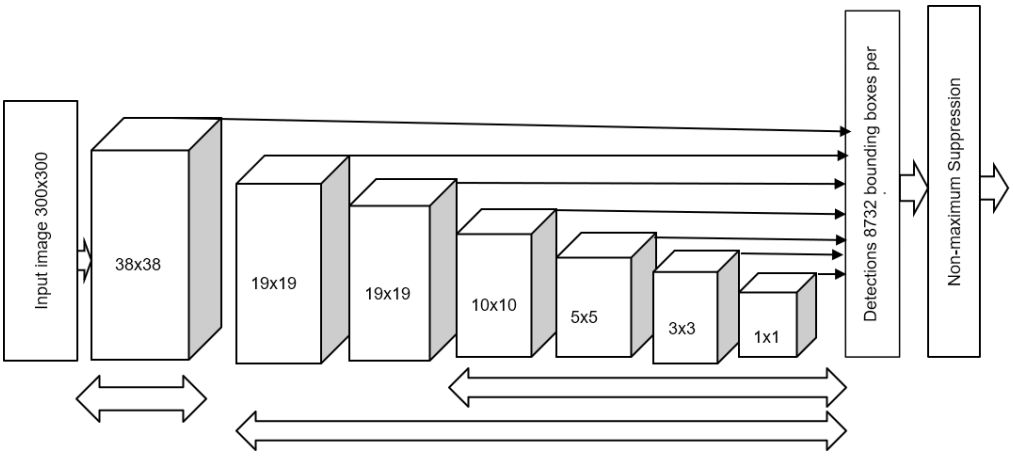

Figure 8: Architecture of SSD Model [5]

In the above model the input image is feed toVGG-16 network which extracts the features of the image. After that a series of convolution layer will create multiple bounding boxes for each object detected. And finally Non-Maximum Suppression remove the duplicate bounding boxes and detect the object by using maximum confidence value.

6.2 THE RASPBERRY PI

Raspberry pi is an efficient and powerful minicomputer developed by Raspberry Pi Foundation, United Kingdom. It is popularly used in projects like Image processing, Internet of Things (IOT), Robotics, Object detection and many more. From the invention (2012) of Raspberry multiple models has been launched such that Model B(2012),Model B+(2014),Model 3B(2018),Model 4B(2021).Among the models we have used Model 4B with 2GB RAM for our project.

6.2.1 SPECIFICATION OF RASPBERRY PI MODEL4B (USED MODEL)

Here a Quad Core Cortex A-72, 64-bit, 1.5 Giga Hertz processor has been used and the RAM used may be 1-8 GB, Bluetooth 5.0, 2.4 Giga Hertz and IEEE 802.11 AC wireless LAN has been for connectivity.

7.RESULT

Here in this projects COCO (Common Objects in Context) [7] has been used. SSD model with COCO data set can identify 80 classes of objects. Among these 80 objects only the animals and person are filtered. Each class of objects has a specific class ‘id’. When an object is detected then the model returns the specific class ‘id’. And using this class id all the sensors are connected to get an alarm for the driver of the vehicle. The accuracy rate of our proposed model used for object detection and classification is approximately 90%.The proposed model achieved precision of 92.02%, recall of

93.79%, F Measurement of 95.9%. Here the model can detect the following animals in real time.

Table1: Class Id of each object detected

Class Id	Object Name
‘0’	[Nothing]
‘1’	[Person]
‘17’	[Cat]
‘18’	[Dog]
‘19’	[Horse]
‘20’	[Sheep]
‘21’	[Cow]
‘22	[Elephant]
‘23’	[Beer]
‘24’	[Zebra]
‘25’	[Giraffe]

Following are the results so animal detection by using web camera or by android mobile camera.

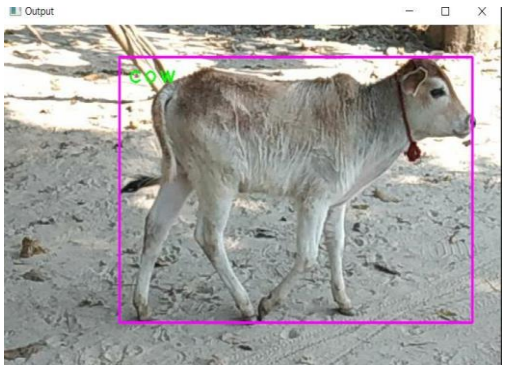

Figure-9: Cow detected from camera.

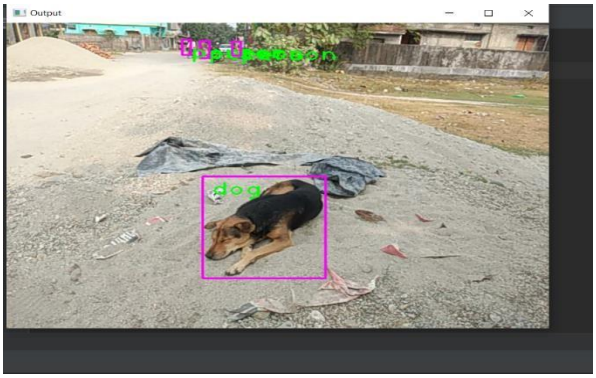

Figure-10: A dog detected

Figure-11: Person detected

8. CONCLUSION

In this paper the SSD object detection model for object detection using Raspberry pi has been proposed and used. SSD is a lightweight algorithm which can run on raspberry pi easily. This model can be used in various fields to solve some real-life problems like

object detection and object classification. Here in this paper this model has been created to identify only animals enlisted above table 1.SSD model with COCO dataset can identify total 80objects but here only the listed objects among 80 objects are extracted out. Although the proposed system gives good result still the system has some limitations due to factors like limited resolution, changing lighting, and complex backgrounds. Based on these constraints we will look at further efficient ways to address these issues and attempt to improve our performance. To enhance the performance of our model and support the adoption of these techniques in practical applications additional research will be conducted in this area.

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