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Object Recognition for Visually Impaired using Machine Learning

Dr. Mamatha G[1], Bharath Roshan B R[2] , Vasudha S R[3]
[1]*Head of the Department,* [2]*Student, Information Science & engineering, Nagarjuna college of engineering and technology, Bangalore, India*

Abstract*: The concept of Object recognition is the most recent and the evolving topic in the field of Artificial Intelligence, which helps the machine to identify the objects which is present in the surrounding environment and recognising that object from the dataset. For identifying the objects from the dataset there is a lot of classification so that the object to be identified can be identified accurately. This will help the visually impaired person to know their surroundings better, which can guide them in every step they take. This will be the helping hand for the person to avoid obstacles which is on their way.
Keywords: COCO, CNN, YOLO, Neural Network

I. INTRODUCTION

As a normal human being can use their eyes to look around them which helps them to detect and identify the object they are looking into. But it is a disadvantage for the visually impaired person as they cannot look around them to know what is going around and what is present in their surrounding environment. So, we have designed spectacles which will be a helping hand for the visually impaired person to know their environment much better like a normal human being can. We have used an algorithm known as You Only Look Once (YOLO). As the algorithm says, the camera which is present in the spectacle's observes the surrounding only once to identify the objects and the animals around.

II. DATASET

A Dataset is a collection of all the data points that is required by the algorithm to train itself to get a better prediction so that the result can be more accurate. The dataset consists of many columns and the columns header i.e., under which the data points are present. In this paper we are using the COCO (Common Object in Context) Dataset which was developed by Microsoft. This dataset consists of more than 7 million images that is classified into 80 different classes so that it can be easily recognised. This dataset mostly consists of the different common objects which we see around us in our day to day life.

III. BACKGROUND

Object Recognition plays a vital role in Artificial Intelligence. It is used in many of the upcoming technologies like the self-driving cars, video surveillance. The object recognition as some of the pre-built models in CNN, R-CNN. In object recognition the machine plays a vital role in finding the features of the objects under some of the predefined classes in the dataset. This classification is known as the object classification. Object Detection and classification is the two main building blocks of Artificial Intelligence.
The Proposed system is to implement the technology of object recognition in the spectacles used by the visually impaired which will help them to detect the objects and the obstacles which is present in front of them. The system uses Raspberry Pi, Earphones, Miniature Camera, Wi-Fi Module and USB interface.

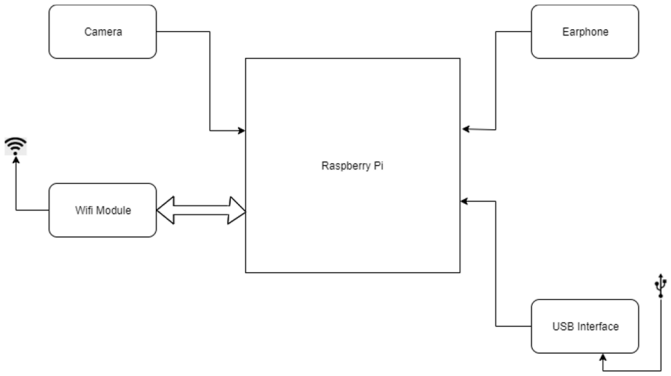

Fig 1 - System Architecture

Here the camera is connected to the Raspberry Pi which detects the objects present in front of them. The camera captures the video. From the video the objects are detected and features of that object are considered and from the dataset class of the object is recognised based on those features and the object is detected.

Now, after the recognition of the object is completed the name of the object is then converted to speech, so that it can be heard by the visually impaired person.

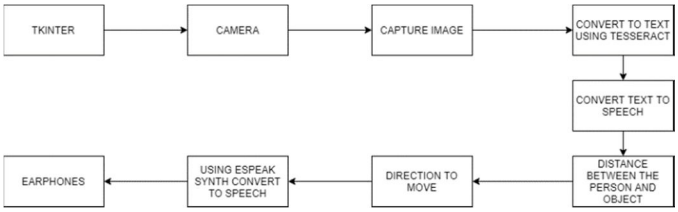

Fig 2 – Flow Diagram

The above flow diagram displays the flow of data from the camera till the voice output is given to the visually impaired person. Here based on the recognized object the learning algorithm keeps on learning as soon as it recognises the objects and stores the recognised features and the x-axis, y-axis and the z-axis coordinates in the dataset so that if the same object is to be recognised in the future, then the same coordinates can be used to identify the object.

Here we are also using Ultrasonic sensors to find the distance between the object and the person. This will guide the person to move when they are on the road where there are lots of obstacles on their way and with the help TCS3200 Sensor Module they can identify the colours of the traffic signal. This can help them to cross the road with traffic signals. This sensor consists of square boxes that is present inside the eye of the sensor. These boxes are used to recognise the different colours.

Some of the previous solutions to given to the visually impaired person consists of RFID chips that is used in the sonar sticks that is used by the visually impaired person. This solution is very much expensive, because of the cost of the RFID sticks used and it is not vulnerable to the sun and rain which can damage the device.

IV. YOLO

YOLO refers to “You Only Look Once” is a deep learning algorithm that is used to detect and recognise the different objects present in the surrounding environment. The following figure represents the flow of how the objects are classified.

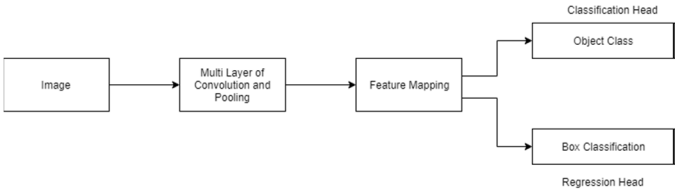

Fig 3 – Classification in YOLO

In YOLO once the image of the surrounding is captured, the objects in the surroundings are divided into regions, these regions have some predicting bounding boxes. The bounding boxes which are created have some particular weights that are weighed using the predicted probabilities.

$$\lambda_{coord} \sum_{i=0}^{S^2} \sum_{j=0}^{B} \mathbb{1}_{ij}^{obj} (x_i - \hat{x}_i)^2 + (y_i - \hat{y}_i)^2$$

Fig 4 – Output of YOLO

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V. CNN

The Human Brain consists of many neural networks that helps us learn by our self and remember what we have learnt. Similarly, in Deep Learning we are creating an artificial Neural Network that learns on keeps on learning by itself as it collects the features after detecting the object.

Here in this paper we are using the convolutional neural network which is a type of artificial neural network. The CNN consists of perceptron which is a machine learning algorithm. The main building blocks of CNN are Input Layer, Output Layer and many hidden layers that keeps on growing as the algorithm learns.

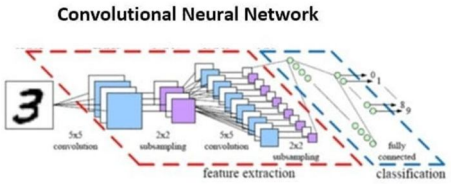

Fig 5 – CNN Model

The layers in the CNN is a regularized multilayer perceptron. This means that it is a collection of the fully connected networks, i.e. each neuron in a layer is connected to all the other neurons that is present in another layer. Here the fully connected networks refer to making the network prone to overfitting data.

The hidden layers in CNN consists of a series of layers that is the convolve of dot product. In the hidden layer, the input and output are masked by the activation functions and the final convolution is formed.

VI. CONCLUSION

The implementation of the object recognition that would be helpful for the visually impaired person to guide themselves and understand perfectly the object in front of them and the distance between the obstacle. Instead of the traditional methods that include walking canes and wheelchair which is difficult to use in public places.

The proposed system provides much more accurate and more information than a conventional guiding system, as it can be used in different environments as it can be used in both indoors and outdoors.

By using this the visually impaired person can quickly become acquainted with their surroundings and can be prepared to react quickly in any circumstances which can occur at any time.

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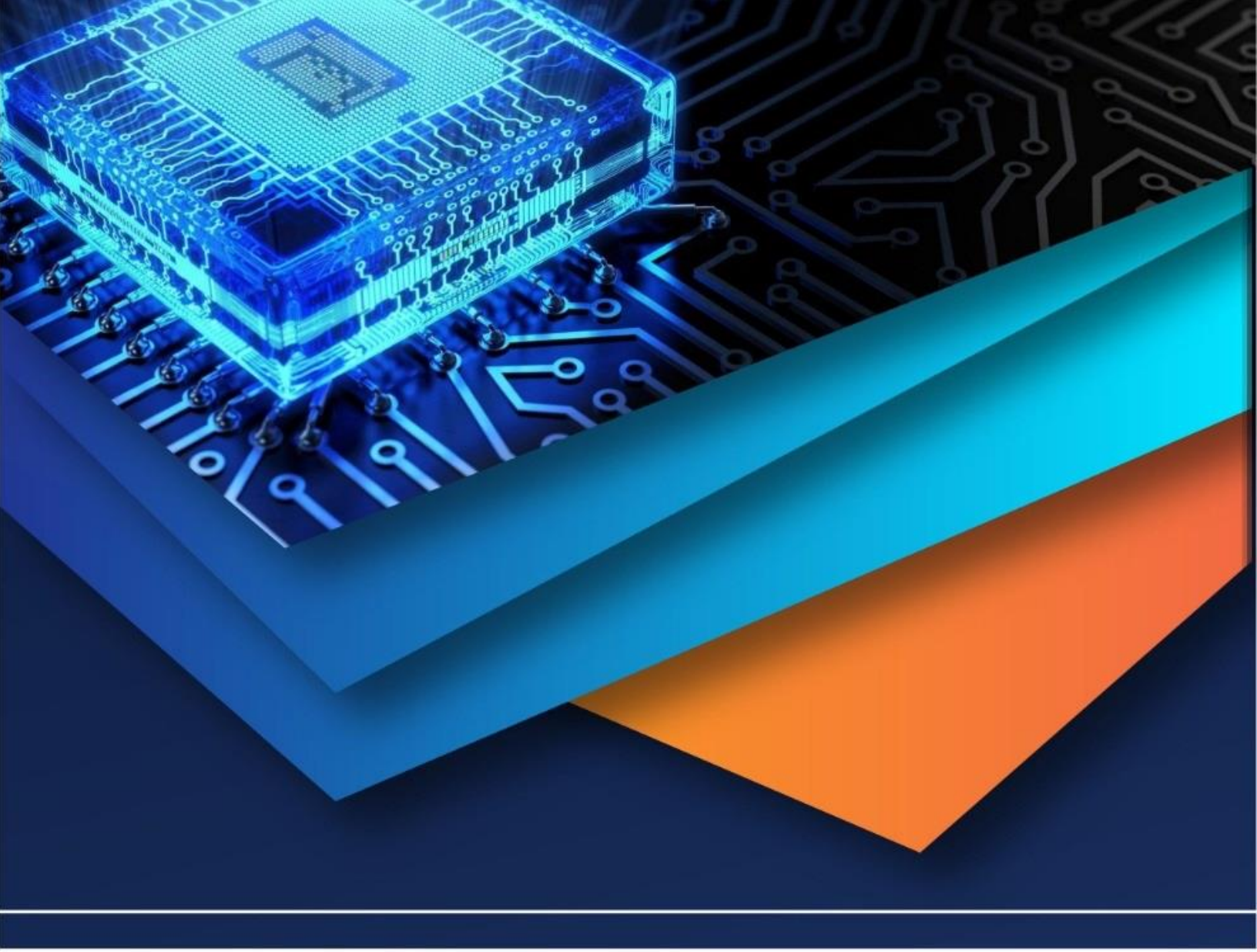

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