International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 07 | July 2020 www.irjet.net p-ISSN: 2395-0072

A Novel Way for Circular Object Detection using Deep Learning Network

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Abstract - *These days' digital data is flooded with digital images and videos which are present almost on all social networks. Online websites and social networks like facebook, linkedin and amazon and so many have these stuff in the billions. The field of computer vision research has been dominated by machine learning and statistics. If the data is more complex and require deep understanding then deep learning is used worldwide. Using digital images and videos to detect, classify, and track objects or events in not an easy task. It requires deep understanding of a real-world scene. So designing an algorithm for detection and recognition require expertise in the area of computer vision. Computer vision has many applications like digital image searching, navigation, medical image analysis for tumor detection, photo management and many more. Computer vision proposes that a digital image is a scene consisting of different objects of interest and a background represented by everything else present in the digital image. Actually each single object is labeled with its pixel values present in that digital image. Corresponding relations among these objects are the prime factors for real time scene understanding. Both the object detection and recognition are important steps in computer vision tasks. Former determines the presence of an object as well as its scope with position in the digital image. Object recognition recognizes the object type in the training image database, to which the particular object belongs to. In this research paper a novel technique based on deep learning network is proposed to detect circular objects present in the digital images. This proposed technique will be compared with other known technique of the circular object detection.*

Key Words: Circular objects, object detection, deep learning, image processing, Hough transform

1. INTRODUCTION

The world around us is known as visual universe and computer vision takes it using images as well as live videos. The fundamental work of computer vision technology is utilizing image classification into different groups, feature detection and recognition and segmentation. In short classification of image means searching prime facts in the internal parts of the digital image. Detection of different types of objects in a digital image depends on the relative positions and also the different classes of objects. There are two types of segmentation. First one is semantic which is used for classification of pixel and second one is the instance which is used for labeling of pixels which is of the same object.

In old times computer vision operations are performed with the help of different design features which are not automatic like Gaussian and Gabor filtering and different featured transforms. These days Deep Learning which is based on neural networks is working tremendously for the given field. The machines are now becomes fast and with the use of these techniques different features of different objects are learned very easily and finally can easy recognize and detect objects.

Real time object detection works on very rough images which contains different and many objects which are at different position and at different angles and have blurred backgrounds. Objects can be present at any location and also overlapping of objects can be there also. Benefit of the object detection is that if also draws the outer and inner boundaries of different objects.

Object detection is fairly one of the most difficult tasks as objects are in the real world. These days different deep learning methods which are relied on the convolutional neural networks are used to solve this type of problem and shows greater results. It includes YOLO, SSD and R-CNN and RetinaNet and many more.

Different techniques for detection of objects are classified here

1. First type is the suggesting the region first of all. In these regions the object is present with high probability and is figured out with the help of either selective searching methods like older vision methods or with the used of deep learning methods which is relied on proposing a region (RPN). After getting the some grouping windows one can easily create a function that has different regression prototypes and different prototypes for classification so that object detection is possible. Faster R-CNN, R-FCN and FPN-FRCN are in the group. These algorithms have double stage behaviour. These are preferred due to their accuracy and are rejected due to their slow processing speed.

2. This category works effectively when the different objects are of some fixed size as well as fixed position. Both position

as well as size is manually adjusted so that maximum cases can be covered. The prime advantage of these methods is that the initial image is converted into some fixed resolution grids of images. For every subpart these techniques estimate the exact number of objects of pre defined shape and size. These methods are also known as single phase. YOLO, SSD and also RetinaNet come into this group. These are used because of high speed of execution and are rejected due to low accuracy.

The detection of circular objects is of very importance in the area of digital image processing and recognition of some pattern of objects and also in the computer vision etc. Traditional technique for detection of circular objects is primarily focused on the use of well known Hough Transform for circular objects. This algorithm first of all find and draw the boundaries of the object and then uses the mathematical transformation for converting edge points into the parameter space with the help of center points and radius.
In the parametric region the location point matches to circular objects can be taken with the help of some statistical methods by any mechanism so that circular objects can be visualized. Since there are lots of parameters so these Hough transform based techniques are very slow in execution and also need high memory. So these techniques are usually of low importance. So, worldwide researchers are come with some new theories such as use of probabilistic Hough Transform so that there is some good improvement over the traditional one.

2. LITERATURE SURVEY

Z. Chen et al. [1] proposed a three dimensional circular object detection algorithm which was relied on the binocular stereo vision. The proposed algorithm first of all detected and tried to fit the ellipses as well as circles in the given stereo digital image. Then after stereo matching sub pixel mode disparity image data was obtained amid two digital images with the help of applied mathematical prototype. With the theory of binocular stereo vision prototype the disparity data that was received is projected in three dimensional spaces in reverse mode.

With the use of available thresholds for parametric evaluation the amount of extended deviation from circular as well as coplanar objects could be used to detect spaced circular objects which were relied on three dimensional data. Authors used forty different types of coplanar data were processed with the help of six different proportions. Various experimental outcomes showed that the proposed algorithm could detect and recognize circular objects efficiently which had good precision as well as high efficiency. From the observations it was found that the correct recognition rate was quite high near to 95 percent, which was very much effective for detecting circular objects accurately in real time world.

Le et al. [2] proposed and analyzed a new technique for detecting circles in the digital images which was relied on the detection of line segment as well as verification of the circle completeness property. The prime logic in the proposed algorithm was utilization of line segments in place of just edge pixels so that circle could be determined which was governed by some verification rule so that complete circle could be determined. The main aim of proposed algorithm was to achieve accuracy, robustness and efficiency in comparison to other methods.

The proposed algorithm had been relied on the four different parameters which were circle ratio, completeness, distance and normal tolerance (α). The image minimum size was set to half and normal tolerance to twenty degrees while circle ratio and circle completeness values were 0.6 and 180 degrees respectively. Authors sat 180 degrees as default value for completeness as in experiments natural images were taken where circles which had angle less than this degree was rarely available. Benefit of proposed technique was that it could handle the different types of circles like concentric, discontinuous and other irregular shapes which had some quantity of noise as well as different types of deformations. The only limitation of the suggested technique was that it could not find the small circles as the algorithm failed to find line segments with the help of approximation methods applied on highly curvature curves.

N. H. Lestriandoko et al. [3] suggested an adaptive circle detection technique with the help of Hough transform in two dimensional digital images. Authors used the Maxican Hat filtering method to find local maxima with help of peaks generated by the Hough. With the help of this strategy center as well as radius of circle could be searched easily and accurately. Authors compared the results of suggested method with the older and original Hough transform.

The practical experiments were performed on system with RAM 1.80 GHz with 4 multi core CPU and had utilized ROOT C++ as programming language for implementation purpose. There were total seven digital images were considered for simulation purposes. Out of those three images were in good condition and which other four digital images had noise with mixed shapes. The Maxican hat filter could enhance the accuracy for finding circles in all digital images. In case of coin digital image outcomes of the filter provided the best results for complete round circles. For the images that had noise in its internal structure algorithm also performed well with good speed of execution. From the experimental study it was clear that proposed algorithm worked better in comparison to traditional Hough transform and was very efficient in case of fastness. So the algorithm for circle detection provided the best results also for those circles shapes which had any type of noise.

J. Ni. et al. [4] worked on finding the total number of different objects present in the digital image automatically. Methodology of algorithm was that if there were some

objects which were overlapped with each other than those objects should be detached so that counting of objects could be done easily. Traditionally Hough transform was utilized to find and count circular objects whether those were overlapped or not. But it was not possible for this transform to detach the overlapped circular objects accurately so it would provide inaccurate outcomes when there was overlapping of objects. So for solving this kind of problem authors proposed an intelligent and combined method which was relied on Hough transform and contour detection algorithm. A software was implemented with the help of computer vision open source library Opencv 3.0 and with visual studio 2012. The practical outcomes showed that the proposed method could easily extract or count the objects efficiently. This suggested methodology successfully partitioned all the circular shaped objects whether it was coins or any random shaped object like a pen with the coin.

B. Zhou et al. [5] also implemented the Hough Transform which was one of the popular techniques to extract different shapes from digital images. Author tried to overcome the drawbacks of this transform as it required very high computational time as well as large storage. This transform which was known as Vector Quantization of Hough Transform (VQHT) was first implemented to search straight lines and then it was implemented for circles. The fundamental idea behind the algorithm was to divide the edged digital image into its subsequent images by using proposed algorithm as this algorithm worked on the spatial relationship. The suggested VQHT algorithm was very efficient to find the circular patterns easily from the digital images which had different modes of noise present. The proposed algorithm took very less execution time in comparison to well know SHT as well as RHT algorithm. Also the storage needed for this algorithm was also low as compared to SHT as well as RHT techniques for detecting circles. As a result of this algorithm the overall efficiency of circle detection was increased as individual pixel either belongs to one instance of individual circle parameters.

3. PROPOSED ALGORITHM AND RESEARCH METHODOLOGY

3.1 Proposed Algorithm

The hybrid algorithm includes fusion of edge detection and Hough transform. The specific process is as follows:

(1) Operate edge detection model to train model
(2) Apply Hough transform on image to train model
(3) Extract features for circular object detection.

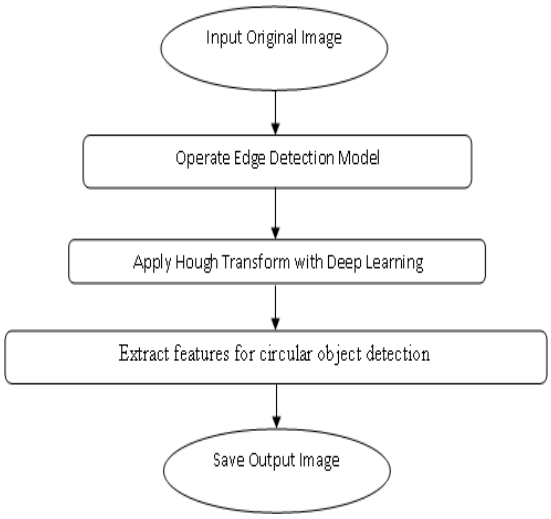

Fig -1: Flowchart of proposed algorithm

3.2 Methodology

The following strategy will be followed to get the desired results.
Step 1: Various existing object detection and segmentation algorithms were studied and analyzed.
Step 2: Various existing circle detection algorithms were studied and analyzed.
Step 3: Model is trained for detection of circle using deep learning.
Step 4: Different size and different number of circle present in images were detected.
Step 5: Accurate circle detection with clear boundary results were achieved.

4. RESULTS

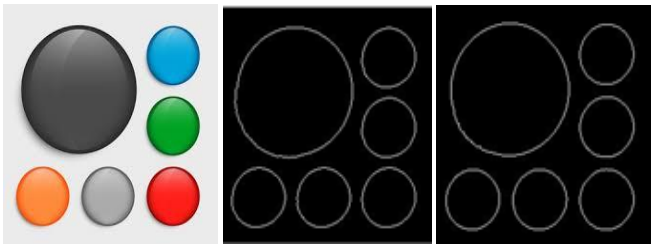

Fig -2: Original Hough and proposed image results

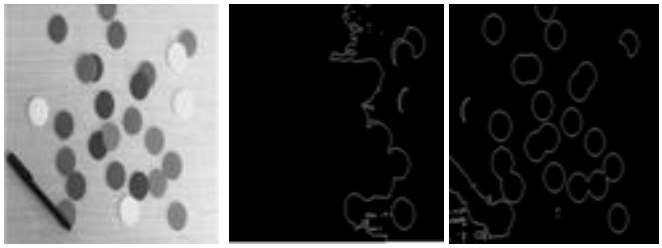

Fig -3: Original Hough and proposed image results

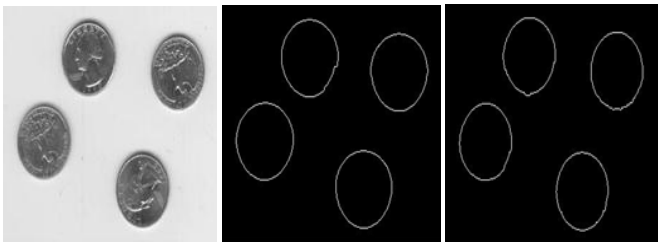

Fig -4: Original Hough and proposed image results

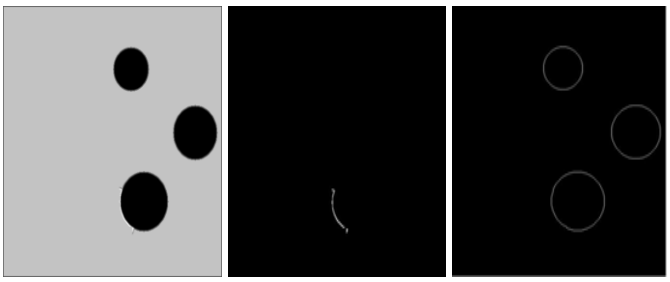

Fig -5: Original Hough and proposed image results

In the figure numbers from 2 to 5, first image is the original sample image. After applying well known Hough transform the result is obtained which is second image and last one is obtained by applying proposed algorithm. From the above results it is cleared that the proposed algorithm redefined the edges of circular objects very clearly as well as in fine way.

5. CONCLUSIONS AND FUTURE WORK

From the results it is cleared that proposed algorithm tries to find the exact boundary of a circular object in digital images in comparison to standard Hough transform. The outcomes of the proposed filter have refined edges and not remove any detail present in the image. While the Hough method usually fails at most locations under some condition. So the proposed technique is better in comparison to standard Hough filter technique for finding circular object in digital images.

In the future work different techniques can be combined to retrieve other better outcomes in comparison to the proposed techniques. Other objective parameters can also be taken in consideration so that more accurate detection will be possible in the digital images.

ACKNOWLEDGEMENT

I want to thank my supervisor Ms. Pratibha Verma to provide me deep knowledge in the deep learning domain. Also I want to thank Professor G. N. Verma and Mr. Kapil Kumar for providing me their valuable help throughout this research.

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