Study of Object Detection Methods and Applications on Digital Images

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***Abstract*: The recognition of the substances of the real world in the form of the moving image or digital pictures is the object detection system. The object belongs to class of objects like as vehicles or person. Object detection is widely used in industries that are required for the safety and the production of the organizations. The wide range of applications in object detection is in recovery of the images, safety approach, investigation purpose, machine system assessment, computerized vehicle structure. Object detection based on machine learning is an important application in machine learning where the strong capability of the feature learning and the feature representation that is compared to the object detection techniques. Object detection is a challenging issue in the analysis of patterns and computer systems. The relation between the video analysis and image processing in object detection has emerged in recent years. The construction of the complex structure combine the low level features with the high level context features and the evaluation is done on the basis of the classifiers. With the advancement in the machine learning, various deep level features have been developed to address the problem of the traditional architecture. In this paper, a review on machine learning approach based on object detection framework. The applications of the object detection have been summarized. The different approaches of the detection of the objects using template based, part based, region based, contour based method.**

***Keywords*: Machine learning, Object detection, Classifiers, Image processing.**

I. INTRODUCTION

1.1 object detection

Object detection and tracking in wide research areas in computer vision and other applications in traffic detection, traffic detection, vehicle navigation, interpersonal connections. Object detection is a computer equipment which is related to computer visualization and image processing that deals with detecting examples of semantic objects of a certain class (such as humans, buildings, or cars) in digital images and videos. The wide area of applications in object detection is face detection, face recognition and video object detection. Some of the applications are, tracking motion of the ball, tracking ball during the match, tracking person in a video. Normally, Object detection has uses in many areas of computer vision, including image fetching and video surveillance [1].The object detection system recognizes the presence or the absence of the objects in certain scenes and the cameras viewpoints. The various domains of the object detection based on the different objectives and classified on specific and conceptual categories. The object detection based on the various models either explicitly or implicitly. The components may vary based on the different approaches. The selection of the object based on the hypothesis and the selection based on the matching. The object detection is an appropriate technique for the processing. The object detection is the searching of the objects where the images are found in real world applications.

1.2 Features of the object detection

In the object detection, tracking and the selection of the various characteristics features that can reduce the work accessibility of the computer. When the tracking is done using various algorithms the combination of the different features determined in various steps [2]:-

i) Color - The feature of the computer system that is used for the histogram appearance representations. The widest features of the color representations are the features of the color representations for the tracking. The features of the color are tracking of serious problem which recognise the illumination variation.

ii) Histogram of gradients - The HOG feature is the most popular feature used for the detection of the human body. The operations of the histogram feature based on the local grid unit of the image. So the geometric variations influence the optical deformations. Moreover, the sampling orientation and local optimisation maintain the upright posture and body movements. These movements do not influence the detection phase which is the main reason of HOG feature in detection of humans[3].

iii) Edges - The boundaries of the image intensities may change during the identification of the object detection. The feature of the object detection is different from the color features technique[4].

iv) Optical Flow - The feature based on the motion segmentation and the applications of the tracking. Thedisplacement vector recognise about the every pixel of the region. The displacement vector is that which determines the transactions of each pixel of each image.Optical flow is usually used as a feature in motion-based segmentation and tracking applications. It is a dense field of the displacement vectors which defines the translation of each pixel in a region. It is computed using the brightness constraint, which assumes brightness constancy of consistent pixels in consecutive frames. With the development of technology, there are many popular techniques for computing dense optical flow, such as Horn-Schunck Algorithm[8].

Challenges of object detection:-

i) Positioning -In this process, the position of the image can be changes at any time. In the template matching the system will handle the images uniformly in the system[6].

ii) Lighting - In this lighting conditions may change during the course of the system. The changes in the weather may affects the lighting of an image. In such case, the lighting condition may vary with the time. The shadow of the image affects the image lighting system. The detection of object from an image can be done during any condition of the lighting.[5]
iii) Rotation -The images may be rotated t where the system may be capable of handling such type of the difficulty. For instance, character may appear in any form, but the orientations of an image are not affected by the detection of the character.
iv) Mirroring - The images which are mirrored of any object can be detected by the object detection system
v) Occlusion condition - When an object are not visible then then image and that condition is referred as occlusion.
vi) Scaling method- The object detection system are not affected by the change in the size of the object. The challenges may occur due to the object detection. The scaling method is the process of the recognition of the scaling of the images in the object detection [7].

II. FUNDAMENTALS OF MACHINE LEARNING

Machine learning is the field of the computer system that evolved in pattern recognition and computational learning based on artificial intelligence. The prediction of the data sets based on learning and buildings of algorithms. The building of the models based on the certain procedures for instance is inputs data driven predictions and static program instructions.[11] The machine learning method based in various cases which are:-
i) Absence of the human expertise.
ii)Unable to understand the human expertise such as speech recognition.
iii)The solution method changes with the time.
iv)Adaptions case based on biometrics.
Machine learning can appear in numerous appearances[12]. The number of applications and the types of the data recognise the stylish approach. The key concern about the machine learning is to decrease a range of equally dissimilar problems to a set of equally narrow prototypes. The machine learning based on two approaches:-
i) Supervised Machine Learning- The programmed system trained on already defined approach that facilitates the actual ability for the new data. In this type, the data set determine correct set of the output values and relation between the input and the output. The supervised learning problem includes regression and the classification problem[12].
ii) Unsupervised Machine Learning -The method of finding the data and relations in recognising the patterns is unsupervised machine learning. In supervised learning, the structure of the data affects the variables. The prediction results have no feedback effect on the unsupervised learning approach.The structure by clustering the data based on relationsamongst the variables in the data. With Unsupervised learning there is no feedback based on the prediction results
In this machine learning algorithm, based on the machine learning predictions,. The predictions are described as,
$h(x) = \theta_{0+\theta_1} x$
Where the values are taken as constants, the value x are taken as the input value and the output value. The prediction values are compared with the output value y and the differences are measured by minimizing the alternative value. The optimised equation for the training set of unknown as input values as the estimated input equation. The prediction function recognises the predictor function as the input equation.

III. REVIEW OF OBJECT DETECTION

Han, C., Liu et al., 2018[13] proposed a research on a novel approach to identify the shape of the clustered image. The transformation from queried shape to cluttered image is the core idea in the transformation of the image. A point based descriptively; PAD (Pyramid of arc length descriptor) identifies the pairs between the queried shape and local shape image. The methods were proposed to measure the shape by transforming the shape into domains using wavelet wave transforms and Fourier transforms. Later, various shape descriptors were proposed for measuring the shape similarity. The shapes described by using triangle areas as set of reference point. However the existing shape matching algorithms and shape descriptors are designed for matching the shapes.
Li, C et al., 2018 [14] proposed a research on the object detector based on deep learning of small samples. The algorithms were designed for sample generator for switching the object generator in different scenes. The deepest learning and dense prediction structure were used in a deep convolution neural network. The vanishing gradient and the objects used to improve the accuracy in the object scenarios. The experiments demonstrated that the proposed algorithm has better state of art contrast models and mean average precision higher than other. However, few samples used in the training process and most of the networks flexibly cannot change by different tasks. The background of the indoor scenes is complex and feature of object are weak.so to solve the problem of small samples there are methods of data augmentation such as mirroring image, increasing contrast, and sampling a patch.
He, K., Zhang et al., 2016[15] proposed a research on the classical and deep learning methods in object detection. The emergence of the object detection method focuses on the working principles of the model and performance in real time and accurate detection. The challenges of the object t detection based on the deep learning solutions.The subtraction method has three processes which are background modelling, object detection and background updating. The process of background subtraction is similar to the frame difference method and it a frame and update in a timely manner. The object detection model based on the deep learning approach .Later the models proposed a new idea.
Erhan, D et al., 2014[16] proposed a research on the object detection using neural networks. In the object detection method a deep convolutional network was used, whereas region based conventional network increase the accuracy of the network and decreases the time. The data set used contains 201 labels. The data set recognizes the image and solve the image detection problem. The object

detection used in face detection, image retrieval and automated parking systems. The main use of the object detection is the classification of the image. The object detection used in various fields like defense, architecture.

Kamate S et al., 2015 [17] proposed a research on tracking and detecting the moving objects from unmanned moving vehicles (UAV) to protect the united states from illegal border crossings. UAV plays important role in industries. The detection of the moving objects can be daunting tasks and objects can be detected using several methods such as histogram oriented gradients, background subtractions. In this research, the main objective is to assist the human operations by implementing intelligent visual surveillance systems which helps in detecting and tracing the unusual events of the moving objects. In this research the different methods had investigated for detecting moving objects from the UAV.

IV. METHODS OF OBJECT DETECTION

The various object detection methodsare described as-

i) Template Based Object Detection - In this method, the small parts of theimage can be recognised using the template image. This technique is also called as the template matching. The quality of the mobile robot parts of the image used as the quality control image and also detects the edges of the image. The relation between the template image and the real image are detected through the geometrical parameters. The data image for the template matching use different iterations for the geometrical parameters. The geometrical parameters with the search images S(x,y) where (x, y) represent the coordinates of each pixel in the search image[18]. The methods are implemented by usingsearch image to find the templates. The origin of the template move over every pointof the search image and compute the amount of products between the coefficients over the whole area spanned by the template. The positions are considered with highest score positions. The method is spatial filtering and the template is filter mask.

(a) Data image

(b) Located template

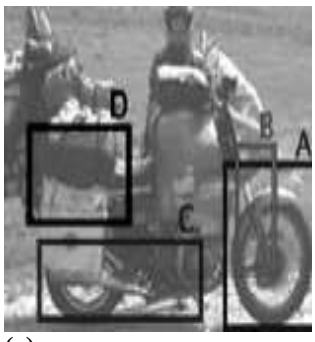
Fig.1 Pattern Matching Method [18]

ii) Part Based Object Detection - The collection of the deformable configuration for the representation of an object. Each part of the models is separately arranged with the deformed configuration and that are represented by the connections between the pairs of the parts. Such models determine the visual appearance of the qualitative descriptions and that are suitable for generic recognition problems

iii) Region Based object detection - The transformation of the input image into directed graph through various rules determined by an algorithm. The graph characteristics symbolize the global shape information of the object inside the input image, and are extracted during the graph construction. The technique represents the traversing of the post preserving of the graph and that will improve the computational time of the graph. Such algorithm is tested through a specific database and that demonstrates the two problems which are object class recognition and similar image retrieval[19].

iv) Contour Based Object Detection -The image data base determines the various types of the objects that are stored by single prototype images. The cameras are used where the robots are locatedand identified by the passing objects. In order to recognise the objects and put them to the final position the image are taken by using cameras. This process based on the two phases. The first phase is the location of the individual objects and describes the polynomial shapes. Almost every kind of the shapes includes the strong connections of the holes. The other phase is the prototypes and detects the type of the objects and calculates the relative orientation. The alternative approach is the segmentation of the image and combining the polygon method that depends on the initial detection of the image. The precision of the triangular approximation is the statistical approach.

v) Appearance Based Detection -In this method the object detection system based on dealing with the 3D recognition system of the objects in the presence of the occlusion and clutters. The appearances are used for the appearances of the images and the scenes. The two dimensional views of the objects based the main classes which are local and global approaches.



(a)

(b)

Fig. 2 Histogram Features of appearance based Detection and (b) Regions D are Unlikely to Contribute for the Classification[19]

a) Local Feature -In this type the objects or the images are located at a single point and small set of the regions. The single point of the data will describe the descriptive property of images of an object. The local feature can be color,gradient and the gray value of a pixel.

b) Global Feature-In global feature the contents of thedataof whole image and the whole pixels of the image are regarded. The statistical measures the mean and the histograms of the features of the images. The reconstruction of the original image and then changes the contrast of the image are the local approaches of the image. The representation of the local image determines contrast of an image.

v)Background Subtraction- In this method the foreground objects are subtracted from the background organisations in the photo frames. The technique in the background subtraction in non-recursive methods are Frame differencing, Median Filter, Linear predictive filter The main objective of this method is that the video frames are estimated using the background model and that statistical properties of frames consumes high memory data storage. The various methods maintain the background estimation based on the input frames and approximation of the median filter, Kalman filter. The recursive method can be declared as the process of the repetitions of the objects in similar way. The single background model can be updated using the new video frames that have the minimum memory storage that is compared to the non-recursive and the computational method.

(a)

(b)

Fig.3 (a) Background subtraction with environment and (b) reference frames

vi)Foreground Detection Method -In this the objects are separated from the background model from the background subtraction.The detection of the foreground image and compares the input video frame input video frames with the background model. After that the pixels are identified from the input frames of the images. Hence, the rate of the detection of the foreground depends on what type of the methods.The other approach is the detection of the foreground for using the threshold based on the normal statistics. Moreover, the issue of this method is the outdoor environment that leads to the spatial variability of known thresholds. The initial background models are compared with the shadow detection and the background subtraction using density and Kernel estimation.

V. LOCAL SHAPE AND GLOBAL DESCRIPTOR

5.1 Local Descriptor - Local Shape descriptor is the method where invariant geometric changes may occur by the rotation and the translation of the scaling and the bending features.The local shape may include the noise and the sampling errors. The geometric shape of the function leads to the change in the shape that may be robust to the noise. The Local shape descriptor is compared to the functions and the scales are linearly changed that are robust the noise. The geometric properties are measured which are not changeable forhandling and are the invariant to rotation and the translation such as length, volume and angle. The scale invariance measures the length of the curve and scaling of object. Theinstance isconnected surface with the sphere of the given radius. The other is the distance such as walking distance of the surface. The small surface features are determined using the qualitative features. The local descriptor based on the three classes, first is based on the local information and other is based on the global data The local data classes are the sample metric that are locally fir to the neighbourhood model[7].

5.2 Global Shape Descriptor - The Global shape descriptor is based on the observation method for each class of the objects. The various properties in the method are more descriptive. For instance, the extraction of the street points position approach and the observation between the fire hydrant and poles. The global descriptor based on i) Smoothing: - The vertical changes with the positions of the vectors with high curvature regions that tends to move at the low curvature regions. This descriptor is used to find the find stimulating points and by the brain mapping community for recognition of the fold surfaces [8]. The other is the shape diameters where diameters of the surface at that point in opposite directions are measured.

VI APPLICATIONS IN OBJECT DETECTION

The various applications of the object detection include various categories are[20]:-

i)Biometric Detection- *The* security and the authentication are determined through the physical and the behaviour traits. The biometric features is the identification of the individual that is based on the biological features such as finger prints, hand geometry, retina and iris patterns, DNA. The object detection method can determine through the template based matching.

ii) Surveillance systems - The videos and object are tracked through the surveillance systems. The object detection is the tracking of the suspected persons or the individuals.

iii) Inspection of the industries - The different parts of the machines of the industry are recognised using the object detection method and the manufactured products or the damage to the products through the monitoring procedure.

iv) Content-based image retrieval (CBIR) - The retrieval of the image based on the content of the image is Content-based image retrieval. In this supervised learning system, automated keyword, annotation of the images and content based image.

***v)* Autonomous Robotics-** The autonomous robots method of the research is the main issue in the recent world of the research. The human robotic systems are the most popular system technique. The vision of the relied system based on the computational behaviour. The termination data is taken as the final data that recognise the functional methods. The computation errors can be decreased through the features of the object obtained from the object recognition methods.

vi) Analysis of the medical analysis -Tumour detection in MRI images, skin cancer detection can be some examples of medical imaging for object recognition.
v) Document Recognition -In this the documents are scanned through the detection methods.
vi) Interaction of computer Systems - In this method the storage of the human gestures in the real time environment and the interaction with the humans. In the interaction system the type of applications are mobile phone , interactive games.
viii) Intelligent vehicle systems - The traffic signs are detected using traffic signs detections and recognitions methods. In this detection phase, the scanning of the scene image determined by the region of the interest (ROI).The sign candidates in the ROI recognised through the waveform features. The speeds up features determine the templates of the data set and the template images are recognised using the maximum number of matches.

VII. CONCLUSION AND FUTURE SCOPE

It is concluded that, machine learning in object detection is an important technique in dealing with the occlusion , positioning ,scale transformation and lighting.The machine learning method has shown the impressive performance on the various vision tasks such as image classification, object detection and object classification. Particularly, the machine learning technique improves the performance based on image classification that discriminate the sub level features. The object detection system recognises the presence or the absence of the objects in certain scenes and the cameras viewpoints. The various domains of the object detection based on the different objectives and classified on specific and conceptual categories. The object detection based on the various models either explicitly or implicitly.The various approaches and techniques of object detection system. The detailed approach on the applications of the object detection system is done. The different methods in the object detection recognise the part based, region of the image and contour basedimage.
The new approach based on machine are required to be developed for the for the detection of the objects to overcome the various issues such as occlusion and scale pattern transformation.

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