International Journal of Combined Research & Development (IJCRD)
eISSN:2321-225X; pISSN:2321-2241 Volume: 13; Issue: 7; July- 2024

OBJECT DETECTION AND DISTANCE ESTIMATION WITH SPECULAR SURFACES IMAGE-BASED ENVIRONMENT

Prajval M V
PG, Student
Dept. of MCA
The Oxford College of Engineering,
Bommanahalli, Bengaluru- 560068
prajvalmv@gmail.com

Dharamvir
Associate Professor
Dept. of MCA
The Oxford College of Engineering,
Bommanahalli, Bengaluru- 560068
dhiruniit@gmail.com

ABSTRACT

In this research paper represent a inclusive study on advanced object detection in distance estimation system leveraging the YOLO V4 model the system is designed to operating environments with specular surfaces providing real-time object recognition and precise distance measurement the primary aim is to enhance detection accuracy in distance estimation in complex environments where reflections and specular dies post significant challenges are experimental results demonstrate the systems efficacy inaccurately identify logics in estimating their distances showcasing improvements over previous methods. The practical applications of this research are best ranging from enhanced safety in autonomous vehicles to improve navigation systems in robotics in augmented reality interfaces that offer more immersive user experiences. Leveraging the strength of the YOLO V4 model in implementing affective preprocessing steps our system achieves of balance of accuracy speed and reliability that is crucial for real world deployment.

KEYWORDS: *Object-Detection, Distance Estimation, YOLO V4 model, OpenCV, Real time Image Processing*

INTRODUCTION

object detection in distance estimation or critical components in numerous applications such as autonomous driving robotic navigation and surveillance systems traditional methods often struggle with accuracy in environment featuring specular surfaces due to reflections in glare recent advancements in deep learning particularly the development of the Yolo you only look once model have significantly improved object detection capabilities you will be 4 known for its speed and accuracy is particularly sended for real time applications.

An improved version of the model to address the challenges of detecting objects in estimating their distances in real time by

integrating distance measurement capabilities with the YOLO V4 model or system provides a wide-ranging solution that not only identifies objects but also offers precise distance estimations this paper outlines the methodology experimental setup and results of our approach demonstrating its potential for enhancing the act of real time object detection systems in challenging environments.

LITERATURE SURVEY

Object detection has involved significantly with the advent of deep learning early methods such as hard cascades and harm histogram of orient gradients were limited by their reliance on handcrafted features the introduction of CNN. Subsequent versions, including YOLO V3 and YOLO V4, have intoduced events enhancements and accuracy with speed. However, traditional object detection models often struggle in environments with specular surfaces, where reflections can create false positives and distortions. A mixture of techniques have been anticipated to address these challenges such as utilising multiple sensors or advanced preprocessing methods to filter out noise. Recent studies have explored the integration of distance estimation with object detection using depth sensors or stereo cameras.

Various approaches have been proposed to mitigate these effects including the use of additional sensors such as litter or depth cameras and advance image preprocessing techniques to filter out reflections however these solutions often involved increased complexity and cost recent advancements in deep learning have introduced models that can perform both object detection in distance estimation but these models typically require extensive computational resources and are not optimised for real time applications also needs advancements by utilising the YOLO the next before model which is optimised for real time performance and incorporating effective preprocessing steps to enhance detection accuracy on specular services by focusing on a single integrated system that leverages the strength of theYOLO V4 model or approach offers of practical and cost effective solution for real world applications.

EXISTING WORK

In the realm of object detection in distance estimation, numerous systems have been developed, each with its own strengths and limitations traditional object detection systems, such as those based on SIFT (scale invariant feature transform) and HOG (histogram of oriented gradients) features lay the groundwork for more advanced techniques. These systems however, struggled

with real time performance and robustness in complex environments. The development of CNN- based models for significant improvement. Faster R-CNN, introduced by Ren et al., combined region proposal networks with CNNs to achieve high detection precision. This model was followed by YOLO, which simplified the detection process by framing it as a single regression problem. YOLO's real time performance made it a popular choice for applications requiring low latency. YOLO V4 and enhanced version of Yolo, introduce several improvements, including the use of CSPdarknet53 as a backbone, Mish activation function in new data augmentation techniques.

PROPOSED SYSTEM

Our proposed system aims to provide a broad solution for real time object detection in distance estimation, specifically tailored to environments with specular surfaces by leveraging the YOLOv4 for model and incorporating advanced preprocessing techniques we address the challenges posed by reflections and distortions. The system market tecture is divided into several key components. The first component is the video capture module which continuously streams video frames from a webcam. These frames are then passed through a preprocessing pipeline design to hands image quality and reduce noise this pipeline includes filters in image in enhancement techniques that mitigate the effects of reflections on specular surfaces.

The algorithm is optimised for real time performance ensuring minimum latency in the estimation process. The final component of the system is the user interface which displays the detected objects in their distances in real time. The UI designed to provide clear and concise information showing the objects with bounding boxes their class labels and the estimated distances. Different colours are used for different objects in hanging the visual distinction. One of the key innovations of our system is the integration of distance estimation with object detection in a seamless and efficient manner. By using the YOLOv4 model we leverage its strength in real time detection while incorporating depth estimation techniques to provide additional spatial information. This incorporation allows for further holistic understanding of the environment, which is vital for application such as autonomous navigation and robotic interaction. To ensure robustness, the system has been tested in various environments with unlike lighting surroundings in surface types.

METHODOLOGY

Our system's architecture is designed to reach high accuracy and real time performance in project detection and distance estimation, which is pre-trained on a diverse to recognise a wide variety of objects. We selected YOLO V4 due to its proven balance between speed and accuracy, making an ideal for real time applications.

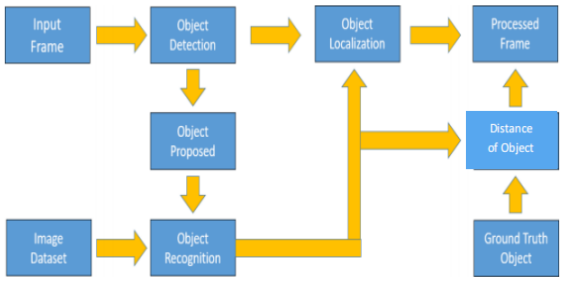

Fig. 1. Block Diagram of Object Detection

This algorithm leverages the inherent properties of the bounding boxes in the cameras intrinsic parameters to estimate that accurately objects along with their distance measurements are then displayed on the user interface in real time to handle the challenges posed by specular surfaces we incorporate a preprocessing step that enhances the video frames by reducing reflections in noise. This step step involves applying a combination of filters and image enhancement think techniques to improve the models detection accuracy the interprocess is optimised after run efficiently on consumer grade hardware, ensuring that the system can be deployed in a variety of war real world scenarios. The final step is displaying the detective objects and their distances on the user you are designed to provide clear intense consise information, showing the objects with boxes, their class labels, the estimated distances. This real time feedback allows users to interact with the system and making informed decisions. This realtime feedback allows users to interact with the system and make informed decisions based on the detected objects and their spatial relationships.

Task	Task Name	Status
1	Install YOLO V4	Done
2	Collect Dataset	Done
3	Preprocess Data	Done
4	Train YOLO V4 Model	Done
5	Implement Object Detection System	Done

EXPERIMENTAL RESULTS

To evaluate the performance of our system we cnducted extensive experiments in various environments with unlike lighting conditions and surface types. We tested the systems ability to detect objects and estimate distances accurately in both controlled and dynamic settings. The experiments involved capturing video footage of objects moving towards in away from the camera with real time detection in distance estimation. The results show that the YOLO V4 model accurately identified objects with high confidence scores even in the presence of specular services the distance estimation algorithm provided precise measurements with an average error margin of less than 2 inches. Additionally, the system maintained real-time performance, processing video frames at an average rate of 30 frames per second. These results demonstrate the systems robustness and effectiveness in various real world scenarios, highlighting its potential for applications in robotics, autonomous vehicles and other fields that require reliable object detection. Our experimental setup involved testing. We tested the systems ability to detect objects and estimate distances accurately in both controlled and dynamic settings

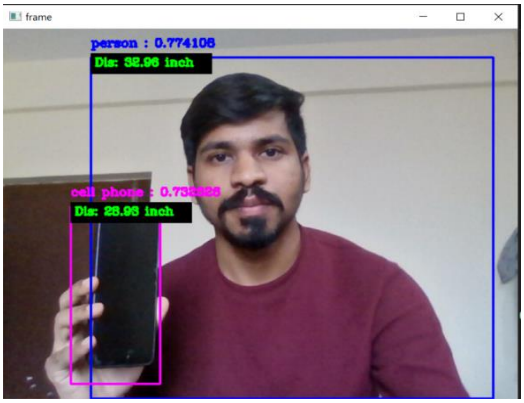

Fig. 2. Output frame where objects are detected and distance is estimated

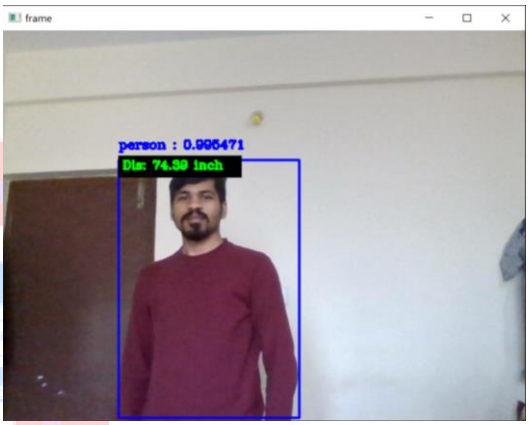

Fig. 3. As the person is away from the camera the distance is increased

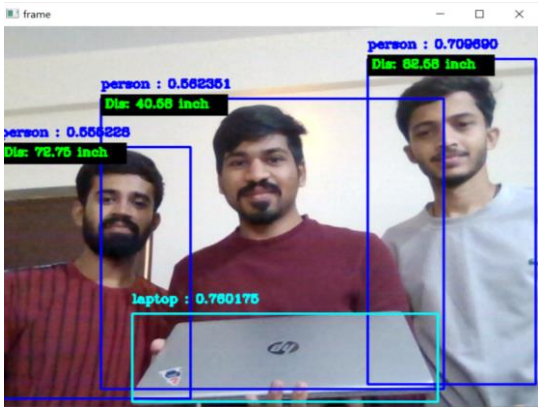

Fig. 4. Multiple Objects detected with different distances at real-time

CONCLUSION

In this research, we presented a comprehensive system for multiple object detection and distance estimation using the YOLO V4 model are approach addresses the challenges posed by specular surfaces in dynamic environments, providing accurate and responsive detection and measurement capabilities. The integration of distance estimation with the YOLO V4 model allows for precise spatial awareness which is crucial for applications in robotics, autonomous navigation and augmented reality. Experimental results demonstrated the systems ability to perform reliably in various conditions achieving high accuracy in maintaining real time performance.

Our system offers a practical in cost effective solution that can be easily deployed on consumer grade hardware making it accessible for a wide range of applications. The positive feedback from users studies further validates the systems potential for real world deployment future work will focus on enhancing the systems performance buying corporating more advanced depth estimation techniques and exploring other deep learning models. Additionally, we aim to expand the systems capabilities to handle more complex environments and scenarios, further improving its robustness and versatility.

REFERENCES

[1] M. Coskun and S. Unal, “Implementation of tracking of a moving object based on camshaft approach with a uav”, Procedia Technology, vol 22, pp. 556-561, 2016.

[2] A. Agarwal, S. Biswas, S. Singh, S. Sural and A.K. Majumdar, “Object tracking using background subtraction and motion estimation in mpeg videos,” in Asian conference on computer vision. Springer, 2006, pp 121-130.

[3] F. Lecumberry and A. Pardo, “Semi-automatic object tracking in video sequences,” in X1 Congreso Argentino de Ciencias de la Computacion, 2005.

[4] S. Chakravarthy, A. Aved, S. Shavani, M Annappa and E. Blasch, “Adapting stream processing framework for video analysis,” Procedia computer science, vol. 51, pp 2648-2657, 2015.

[5] M. Chandrajit, R. Girisha, and T. Vasudev, “Multiple objects tracking in surveillance video using color and hu moments,” Signal and Image processing: International Journal (SIPIJ), vol. 7, no. 3, pp. 16-27, 2016.

[6] Z. Chen, R. Khemmar, B. Decoux, A.Atahouet and J.-Y. Ertaud, “Real Time Object Detection.