

L01 Exploring Real-World Applications of Computer Vision

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Introduction

In a few words, computer vision enables machines to recognize objects, people, and patterns by using deep learning and neural networks. Computer vision uses cameras, sensors, and algorithms that use enormous amounts of data to train, and with the help of deep learning, there is a significant improvement in accuracy and performance. It is similar to how our brain works; we use our vision to detect objects, perform tasks, recognize faces, etc. As it was mentioned in this lab, there are several applications of computer vision, like facial recognition, autonomous vehicles, medical image analysis, and many others. The main benefits include an increase in operational efficiency, an enhanced customer experience, and an improvement in safety.

Computer Vision and Autonomous Vehicles

After exploring and analyzing real-world applications of computer vision, I decided to select autonomous vehicles. An autonomous vehicle uses technology to operate without human intervention by using multiple sensing technologies. Technology like LiDAR, radar, ultrasonic sensors, GPS, and high-resolution cameras are able to sense the environment, interpret visual data, and make real-time decisions.

The way computer vision works in autonomous vehicles consists of the following steps:

- Image acquisition (cameras capture lane markings, traffic signals, pedestrians, cyclists, and obstacles)
- Preprocessing (clarity is enhanced and noise is reduced)
- Object detection and recognition (models use bounding boxes, and classification is performed)
- Semantic segmentation (classification of the whole scene to fully understand the drivable area and detect hazards)
- Tracking and prediction (after the systems detect objects, they are tracked, and the system predicts future movement)
- Decision-making and planning (the system in combination with sensing technology, chooses maneuvers like braking, accelerating, steering, lane-changing, and stopping)

Some of the benefits of autonomous vehicles include:

- Improved road safety (by detecting hazards faster and not getting distracted or tired like we do when we drive, there is an improvement to road safety)

- Reduced traffic accidents (as we all know, the majority of crashes are human error; automation can prevent collisions)
- Enhanced traffic flow (autonomous vehicles can reduce congestion by maintaining optimal speed and coordinating movements)
- Accessibility and mobility (autonomous vehicles can assist people with disabilities, the elderly, and people who don't drive)

Some of the major challenges include:

- Adverse weather conditions (things like rain, snow, fog, and glare can reduce accuracy)
- Lighting variability (too much light or not enough light can affect object detection)
- Edge cases and unpredictability (when technology is advancing every day, AI is not perfect, and there may be times when it won't predict accurately)
- Real-time processing requirements (autonomous vehicles need to process massive amounts of visual data instantly with low latency)
- False positives/false negatives (misidentifying objects can lead to false positives or false negatives, resulting in failure to avoid hazards)

Future Developments and Social Impact

As I mentioned before, technology advances every day, and the future looks promising for autonomous vehicles. Future advances in sensing technologies and more advanced neural networks will make autonomous vehicles more accurate and efficient. As AI models continue to learn from different driving scenarios, edge cases will be reduced, making them more reliable and safer. From an ethical perspective, there are concerns involving the responsibility during accidents, job displacement for drivers, and the lack of regulations in data privacy. I believe currently, the general public is on the fence about autonomous vehicles, but transparency, rigorous testing, and clear safety standards might improve people's opinion.

I have a car that is a level 2, meaning the system provides assistance with acceleration, braking, and steering, but the driver remains fully engaged and attentive. I like my car's features, but like the majority of the public, I don't feel safe relinquishing full control to an autonomous vehicle. I can see the benefits of autonomous vehicles, especially for people with disabilities, because they allow them to be more independent. I can also see the potential improvement in road safety, but I think it opens a different can of worms when it comes to safety.

References

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