Institute of Aeronautical Engineering

Information Technology

PROJECT

Title: Hybrid Motion Model for Multiple Object Tracking

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Abstract

This project proposes a real-time system for multiple object tracking using the Hybrid Motion Model (HMM). The proposed system combines two different types of motion models to accurately estimate the position and velocity of objects in a video sequence captured by a mobile device camera. The system includes stages such as data acquisition, pre-processing, object detection, and object tracking, and utilizes machine learning algorithms to detect and classify objects in the video sequence. The performance of the system is evaluated based on various metrics such as tracking accuracy, speed, and memory usage, and is compared with existing state-of-the-art systems to demonstrate its effectiveness. The proposed HMM-based approach has the potential for various applications such as surveillance, robotics, and augmented reality.

Introduction

The ability to track multiple objects in real-time is an essential requirement for various applications such as surveillance, robotics, and augmented reality. This project aims to develop a real-time system for multiple object tracking using the Hybrid Motion Model (HMM). The HMM is a popular approach that combines two different types of motion models to estimate the position and velocity of objects in a scene. The proposed system includes stages such as data acquisition, pre-processing, object detection, and object tracking, and utilizes machine learning algorithms to detect and classify objects in the video sequence. The performance of the system is evaluated based on various metrics such as tracking accuracy, speed, and memory usage, and is compared with existing state-of-the-art systems to demonstrate its effectiveness. The proposed HMM-based approach has the potential to have significant applications in fields such as surveillance, robotics, and augmented reality.

Existing solution and it's drawbacks

There are various existing solutions for multiple object tracking, including using object detection and tracking algorithms based on machine learning and computer vision techniques, such as the YOLOv3 and Faster R-CNN models. However, these existing solutions have several drawbacks that the proposed Hybrid Motion Model (HMM) can potentially address:

1.High computational complexity: Some existing solutions require high computational resources, making them unsuitable for deployment on mobile devices with limited processing power and memory.

2.Limited accuracy: The existing solutions may not be accurate enough to track multiple objects in real-time and under challenging conditions, such as occlusion and rapid motion.

3.Inability to handle occlusion: Existing solutions may not be able to handle occlusion, which is common in crowded scenes with multiple objects moving in close proximity.

4.Limited robustness: Some existing solutions may not be robust enough to handle changes in illumination, viewpoint, and other environmental factors that can affect object tracking accuracy.

Proposed solution

The proposed solution for the project title "Hybrid Motion Model for Multiple Object Tracking" is to develop a hybrid motion model that can accurately and efficiently track multiple objects in real-time on mobile devices. The proposed solution combines the advantages of multiple tracking techniques, such as Kalman filtering and optical flow, to improve tracking accuracy and robustness while reducing computational complexity.

The proposed hybrid motion model consists of three main components: object detection, object tracking, and motion prediction. Object detection is performed using a deep learning-based model, such as YOLOv3, to detect and locate objects in a scene. The detected objects are then passed to the object tracking component, which uses Kalman filtering to estimate the state of each object, such as its position, velocity, and acceleration. The optical flow technique is then used to refine the estimated motion parameters and handle occlusion by predicting the motion of the tracked objects when they are temporarily occluded.

Requirements

Hardware Requirements:

1.Camera with a minimum resolution of 720p
2.Stable internet connection (if the project involves cloud-based processing)

Software Requirements:

1.Operating system: Android or iOS
2.Programming language: Python, Java, or C++
3.Deep learning frameworks: TensorFlow, Keras, or PyTorch
4.OpenCV library for computer vision tasks
5.IDE (Integrated Development Environment): Android Studio, Xcode, or Visual Studio

References

1. **Chen, X., & Liu, Y. (2018). Multiple object tracking on mobile devices via collaborative learning. Journal of Electronic Imaging, 27(3), 033008. doi: 10.1117/1.JEI.27.3.033008**.

The study proposes a multiple object tracking system that combines visual features and collaborative learning to track objects on mobile devices. The system achieves high accuracy and can track objects in real-time.

2. **Cho, K., Cho, Y., & Kim, H. (2019). Multiple object tracking on mobile devices using a deep learning-based model. International Journal of Advanced Robotic Systems, 16(4), 1729881419865226. doi: 10.1177/1729881419865226.**

The study proposes a deep learning-based multiple object tracking system that can be deployed on mobile devices. The system uses convolutional neural networks (CNNs) to detect and track objects in real-time.

Thank You