Research Projects

Written By: Terence van Zyl Website: https://tvanzyl.github.io/

Explainable AI in Augmented Reality

This project aims to leverage computer vision techniques within augmented reality, focusing on tasks such as instance segmentation, semantic segmentation, object detection, and object recognition. These applications offer significant value, particularly when integrated into augmented reality experiences. However, an additional challenge lies in providing explainability for the model's predictions, offering insight into the reasoning behind its annotaions. Despite the importance of explainable AI, existing methods often suffer from low latency. Therefore, this project seeks to develop and evaluate realistic expectations for augmented reality applications regarding explainability within the current state-of-the-art frameworks.

~~

Detecting Potholes From Space

The challenge addressed in this project concerns the deterioration of road surfaces due to usage and environmental factors, which necessitates timely responses for both societal and economic reasons. There is a need to continuously monitor road surface conditions and promptly address any changes that occur. Presently, road surface monitoring relies on manual inspections conducted annually. A potential solution involves leveraging satellite technology to observe road surfaces and predict changes in surface quality proactively.

~~

Target Identification and Tracking In Rural Landscapes

The challenge addressed in this project revolves around the continuous recognition of targets by an autonomous system across various scenes or camera views. Target re-identification is crucial in video and tracking systems, particularly in surveillance scenarios where objects move through different areas captured by multiple cameras. Matching the same object amidst changes in illumination, pose, occlusion, and other environmental factors poses a significant challenge. This project aims to assess the application of state-of-the-art techniques in rural landscapes, focusing on tracking Rhino poachers in the bush as a case study.

~~

Animal Welfare Using Camera Traps And Federated Learning

The problem addressed in this project is the need to effectively monitor the health and well-being of wildlife or livestock. To achieve this, it is essential to accurately identify individual animals and track them over time. Utilizing animal biometrics for re-identification enables the continuous monitoring of an animal's welfare. Additionally, by employing models, various anthropometric measurements such as weight and height can be estimated each time an animal is observed. Furthermore, the classification of additional characteristics such as coat quality and pregnancy status is important. Posture and stance can serve as indicators of stress or injury. This project aims to automate these aspects of animal husbandry to streamline and improve the monitoring process.

Timeseries Forecasting

The objective of this project is to implement DeFORMA and extend it to a multivariate (exogenous) version within the Nixtla library. Subsequently, the project aims to conduct a comparative analysis of DeFORMA against various state-of-the-art models within Nixtla, using several benchmark datasets.

~~

Explainable, Sustainable And Responsible Portfolio Optimization

ESG stands for Environmental, Social, and Governance. It refers to a set of criteria investors use to evaluate a company's performance and societal impact beyond financial metrics. The project addresses how we can construct investment portfolios that optimize profit maximization and risk minimization while integrating ESG criteria and ensuring transparency regarding their asset allocations. This transparency should go beyond just which assets and include explainable AI concerning why the assets were selected.

~~

Specialisation Without Forgetting For Models Deployed At The Edge

The problem here is the deployment of a pre-trained object detection model onto an edge computing device, such as the Jetson Nano, which has restricted computational capabilities. Although the model was initially trained on a significant private dataset, the goal now is to tailor it to the specific deployment environment. As a result we do not have access to the private data. This deployment involves incorporating our own collected data from the same classes (domain incremental learning) and potentially introducing additional classes (class incremental learning). However, the challenge lies in avoiding catastrophic forgetting during this process. This project delves into the exploration of cutting-edge techniques to effectively manage catastrophic forgetting within this context.

~~

Others

Information Retrieval

Automated Predictive Maintenance In Tribology