Semantically-Guided Image Compression for Enhanced Perceptual Quality at Extremely Low Bitrates

ABSTRACT: Image compression methods based on machine learning have achieved high rate-distortion performance; however, the reconstructions they produce suffer from blurring at extremely low bitrates (below 0.1 bpp), resulting in low perceptual quality. Although some methods attempt to reconstruct sharp images using Generative Adversarial Networks (GANs), reconstructing natural textures at low bitrates remains challenging. In this paper, we propose a novel image compression method that explicitly utilizes semantic information. Specifically, we send a semantic label map to the decoder, which takes it as input. This semantic information enables the decoder to reconstruct appropriate textures consistent with the corresponding semantic classes. Although semantic label maps can be compressed into relatively small data sizes using common methods (e.g., PNG), the data size is not negligible in an extremely low-rate setting. To address this problem, we propose simple yet effective label map compression strategies, including an autoregressive label map compressor. Our strategies significantly reduce the data size of the label map while maintaining the critical semantic information that allows the decoder to reconstruct realistic and suitable textures. By utilizing this data-efficient semantic information, our method can reconstruct realistic images even at an extremely low bitrate. As a result, the proposed method outperformed existing models, including a GAN-based model designed for low-rate settings and a state-of-the-art semantically guided method, in both quantitative evaluation and user studies. Furthermore, we analysed the effect of semantic information by switching the input label map, confirming that the model synthesized textures appropriate to the given semantic labels.

Congestion Control in Wi-Fi Networks—State of the Art, Performance Evaluation, and Key Research Directions

ABSTRACT: This paper focuses on congestion control in the context of wireless networks. It summarizes basic concepts and key performance metrics pertaining to congestion control and surveys relevant and recent congestion control schemes currently used by most popular applications and services on the Internet. The paper also identifies the unique challenges brought to the congestion control problem when running on wireless environments. It then presents an in-depth and exhaustive performance evaluation and comparison of five of the most widely used congestion control schemes when running on wireless networks for different scenarios with low and high interference. The outcome of the conducted evaluation clearly shows the different performances incurred by the studied congestion control schemes and the impact of the characteristics of wireless environments on the key performance metrics. It also provides some insights on which congestion control scheme should be used depending on the application's requirements. The paper concludes by highlighting the open research directions to advance congestion control schemes to better fit the challenges faced in wireless networks and emergent applications.

Turning Trash into Treasure: Developing an Intelligent Bin for Plastic Bottle Recycling

Abstract: Plastic pollution has emerged as a major global concern due to its enduring nature and limited recycling options. In response to this critical challenge, this paper presents a novel approach utilizing a Detection-Based Reward System (DBRS) alongside an innovative business model to promote effective plastic waste management, reduce plastic waste accumulation in the nature, and uphold environmental cleanliness. Leveraging the YOLOv5 algorithm for its exceptional accuracy, speed, and open-source availability, plastic bottle detection becomes a pivotal aspect of this system. Users seamlessly enroll in the system, triggering an automated detection process that computes reward points corresponding to their deposited plastic bottles. These reward points are meticulously stored within a centralized database. Beyond its operational facets, this comprehensive system encompasses a robust business model, strategically poised to capture widespread engagement with waste disposal practices, thereby contributing to the realization of Sustainable Development Goals (SDGs) geared towards fostering a healthier environment. Notably, the DBRS attains cutting-edge performance in plastic bottle detection, boasting an impressive mean Average Precision (mAP) of 0.973, underscoring its efficacy in tackling plastic pollution.

Automatic Detection of Students' Engagement During Online Learning: A Bagging Ensemble Deep Learning Approach

ABSTRACT The COVID-19 pandemic has reshaped education and shifted learning from in-person to online. While this shift offers advantages such as liberating the learning process from time and space constraints and enabling education to occur anywhere and anytime, a challenge lies in detecting student engagement during online learning due to limited interaction. Student engagement, defined as the active involvement of students in the educational journey, is a critical factor influencing the overall learning experience. This research addresses this challenge by proposing a model using bagging (bootstrap aggregating) ensemble learning applied to 1-dimensional convolutional neural networks (1D CNN), 1-dimensional residual networks (1D ResNet), and hybrid ensemble deep learning models. Utilizing the DAiSEE dataset, our findings indicate that the bagging ensemble of the 1D CNN model achieves 93.25% accuracy, surpassing the individual model by 3.25%. The deep learning ensemble bagging attains 93.75%, outperforming the unique 1D ResNet model by 3.5%. Additionally, the hybrid ensemble bagging achieves the highest accuracy of 94.25%, a 1% improvement over the 1D CNN model and a 0.5% increase over the 1D ResNet model

Interest-Based E-Commerce and Users' Purchase Intention on Social Network Platform

ABSTRACT In the modern era of information overload, e-commerce platforms use recommendation systems to predict purchase behavior based on user interests and past actions. Initially limited to e-commerce websites, these systems now leverage the comprehensive data collection capabilities of social network platforms, giving rise to interest-based e-commerce. This study explores factors influencing purchase intentions within this context, using Instagram as an example and applying the Stimulus-Organism-Response (SOR) theory. Data from 313 Generation Z users reveal that interactions with other users and celebrities, along with visually appealing content, significantly enhance perceived enjoyment, which in turn increases purchase intentions. However, self-indulgence did not moderate this relationship. The study extends the SOR theory and provides practical insights for optimizing social media content and engagement strategies to boost purchase intentions, with discussions on implications, limitations, and future research directions.

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