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Fast Deep Convolutional Face Detection in the Wild Exploiting Hard Sample Mining

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Abstract

Face detection constitutes a key visual information analysis task in Machine Learning. The rise of Big Data has resulted in the accumulation of a massive volume of visual data which requires proper and fast analysis. Deep Learning methods are powerful approaches towards this task as training with large amounts of data exhibiting high variability has been shown to significantly enhance their effectiveness, but often requires expensive computations and leads to models of high complexity. When the objective is to analyze visual content in massive datasets, the complexity of the model becomes crucial to the success of the model. In this paper, a lightweight deep Convolutional Neural Network (CNN) is introduced for the purpose of face detection, designed with a view to minimize training and testing time, and outperforms previously published deep convolutional networks in this task, in terms of both effectiveness and efficiency. To train this lightweight deep network without compromising its efficiency, a new training method of progressive positive and hard negative sample mining is introduced and shown to drastically improve training speed and accuracy. Additionally, a separate deep network was trained to detect individual facial features and a model that combines the outputs of the two networks was created and evaluated. Both methods are capable of detecting faces under severe occlusion and unconstrained pose variation and meet the difficulties of large scale real-world, real-time face detection, and are suitable for deployment even in mobile environments such as Unmanned Aerial Vehicles (UAVs).

Keywords: Deep Learning, Convolutional Neural Networks, Face Detection

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