Chapter 12
Generative Adversarial Networks the Future of Consumer Deep Learning?
A Comprehensive Study

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ABSTRACT

In recent years, deep learning and its subtopics have found a near gold-rush stature in the industry. This booming response has not been restricted to niche applications, but rather to titanic domains such as healthcare, self-driving cars, cybersecurity, and more. This "rise" has consequently led to a large influx of practitioners and users to this domain. One such subdomain is generative adversarial networks (GANs), an application of deep learning centered on image segmentation. The researchers aim to study the trajectory of and attempt to extrapolate the future of this subdomain in an attempt to discern if the meteoric rise of this technique is based on concrete positive results or a trend deemed to ebb. This study aims to first gather the most salient aspects and recent advancements of GANs. Specifically, the study emphasizes the importance of GANs and presents differing types utilized in various domains. Finally, the researchers present the current research gaps and the difficulties that could potentially be faced in the attainment of the aforementioned trajectory of this field.

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INTRODUCTION

In the last few years, Machine Learning (ML) has transformed the very way we look at data in more ways than one. It has widened the span of research by augmenting the predictions made from data in domains ranging from information retrieval to recommender systems, from predicting stock prices to predicting the outcome of the FIFA World Cup! (T. Phung, 2022; Sansone & Sperlí, 2022; Marappan & Bhaskaran, 2022; Soni et al., 2022). It has allowed us to get outcomes and decisions from scopes well beyond those of human competence, in fact allowing us to do so in the case of the stock market and the world cup through unsupervised means. Within the subgenre of ML, generative models hold an eminent spot partly due to their presence in the domain spanning multiple decades. Their primary role stems from situations where directly learning/ training for a goal is computationally inefficient (intractable) using discriminative models. For this exact purpose, as the name suggests a joint distribution is generated of the goal and the training dataset. Their importance is seen primarily in two domains, firstly, they help to better depict data and to model lifelike data through the use of Markov chains or Generative Iterative Processes (Harshvardhan et al., 2020). The second and more popular application of these is their ability to generate realistic samples in a wide array of topics, perhaps most eminently in transforming and translating images, for instance, converting The Starry Night as if it were drawn by Botticelli. Furthermore, upon training amply, they possess the ability to generate photorealistic realism in their representations of objects, and sceneries enough to stump even human experts. In this paper, the researchers will be providing an overview of Generative Adversarial Networks (GANs) from the multi-vantage-point of the background of GANs, the common architectures, the challenges, and the applications. One might be tempted to ask what differentiates this paper from the absolute crowd of papers on and around the topic of Generative Adversarial Networks. Several papers have been published around the review of architectures, predicting diseases in crops, medical imaging techniques, and object detection. However, these have centered around their singular topics as opposed to providing a complete, updated one-stop destination to all these facets. An extensive amount of time has been dedicated to reviewing and filtering a large number of papers. The final goal for what this paper is meant to be is a diving board, a marquee mile marker for beginners and advanced practitioners alike to dive into the topic of GANs. It will empower prospective researchers to take informed decisions while remaining cognizant of the consequences of the same.

BACKGROUND AND SURVEY

The researchers have embraced the literature review approach that aligned with previous studies such as (Alzubaidi et al., 2021). This also yielded us a chance to evaluate and understand the growth trend and the growing research interest into the field of GANs. Following this we experimented with various other keyword searches such as, 'GANs in healthcare', "Applications of GANs", "GANs Architectures", "GANs in the metaverse", Deepfake detection. In addition to these preliminary searches, we also performed a depth-first style search by manually reading the suggested articles of the articles previously shortlisted. The analysis was conducted encompassing the past 6 years (2018- 2023 inclusive). In all openness there were articles preceding these years all the way back to 2016, that being said we believe in creating a research paper that stands the test of time and computational advancements for as long as possible. Hence we decided to target the very bleeding edge of GANs. Before taking a deep dive into