# Generative AI and its Use in Computer Vision Applications for Sustainability

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The goal of this project is to explore the applications of Generative AI in computer vision, specifically for sustainability-focused use cases. We will focus on three core objectives: object detection, anomaly and defect detection, and generating synthetic image data to address the challenge of data scarcity.

**Project Goals:**

1. Object Detection: Implementing AI models for accurate object detection in sustainability-related industrial applications.
2. Anomaly & Defect Detection: Using AI to detect defects or anomalies in materials, contributing to efficient recycling and manufacturing processes.
3. Image Generation: Leveraging Generative AI to generate synthetic data for training models where real-world data is scarce.

**Scientific Merit:** This project tackles the critical challenge of data scarcity in sustainability-driven applications, particularly in niche areas where obtaining labeled data is difficult. By using Generative AI to create synthetic data, we aim to reduce bias and improve model performance. Furthermore, the project will address the challenge of accurate object [1] and anomaly [2] detection in complex industrial processes such as fabric recycling, appliance defect detection, and assembly error identification. This research also extends Generative AI applications to sustainability, offering new insights into how these technologies can be harnessed for environmental benefits [3].

**Broader Impact:** The proposed work contributes to both environmental sustainability and technological advancement. By improving defect and anomaly detection processes, the project can help reduce industrial waste and support circular economy efforts. The findings will also have applications beyond sustainability, including manufacturing and quality control in other industries. The use of Generative AI to enhance data availability and model training will provide broader contributions to AI and machine learning research in fields such as computer vision and defect detection.

**Team Member Goals and Tasks:** The primary tasks for this project are:

1. Conducting a literature review on Generative AI and its applications in computer vision for sustainability.
2. Identifying relevant use cases within the Golisano Institute for Sustainability's projects.

3. Developing and training models for object detection, anomaly detection, and image generation.
4. Creating synthetic datasets to augment real-world data and reduce bias in model training.
5. Testing and refining the models to ensure accuracy and robustness in defect detection and anomaly identification.
6. Extending the models to other sustainability-focused applications and projects.

# References


[1] C. D. Prakash and L. J. Karam, "It gan do better: Gan-based detection of objects on images with varying quality," *IEEE Transactions on Image Processing*, vol. 30, pp. 9220–9230, 2021.

[2] F. Di Mattia, P. Galeone, M. De Simoni, and E. Ghelfi, "A survey on gans for anomaly detection," *arXiv preprint arXiv:1906.11632*, 2019.

[3] A. Islam, S. Jain, N. G. Nenadic, M. G. Thurston, J. Greenberg, and B. Moss, "Image-based machine learning in automotive used parts identification for remanufacturing," *Technology Innovation for the Circular Economy: Recycling, Remanufacturing, Design, Systems Analysis and Logistics*, pp. 507–526, 2024.