Crowdsourced Streetview: Integrating Real-Time Imagery Updates into Google Streetview

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Figure 1. Our system generates real-time Streetview imagery via crowdsourced overlays. These are examples of Crowdsourced Streetview integrating user-contributed images into existing Google Streetview data.

Abstract

This paper presents Crowdsourced Streetview, a system that integrates real-time imagery updates into Google Streetview by leveraging crowdsourced images from social media platforms. Our approach utilizes advanced image alignment and feature detection algorithms to overlay user-contributed images onto existing Streetview data, achieving real-time performance with an image alignment runtime of 19ms per image pair. Crowdsourced Streetview has the potential to provide up-to-date and real-time visual representations of locations, particularly in rapidly changing environments and during events such as natural disasters.

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1 Introduction

Google Streetview provides users with panoramic views of streets worldwide but often contains outdated imagery that fails to reflect the current state of the environment. This limitation is particularly evident in rapidly changing urban landscapes or in the aftermath of significant events. Crowdsourced Streetview addresses this issue by integrating real-time imagery updates from user-contributed photos on social media platforms, enhancing the accuracy and timeliness of the Streetview experience.

Previous research has explored the integration of crowdsourced data into digital mapping systems. Heinly et al. [1] proposed constructing 3D city models using images from Yahoo, while Mooney et al. [2] discussed the potential of volunteered geographic information in updating spatial datasets. However, these approaches have not focused on real-time integration with street-level imagery, which is the primary focus of Crowdsourced Streetview.

The main contributions of this paper are threefold. First, we propose a novel system architecture for integrating real-time crowdsourced imagery updates into Google Streetview, enabling the platform to provide users with up-to-date visual representations of their surroundings. Second, we develop optimized image alignment and feature detection algorithms that achieve real-time performance, ensuring the seamless integration of user-contributed images into the existing Streetview data. Finally, we demonstrate the system's potential to provide timely and accurate visual information for rapidly changing environments, such as urban landscapes undergoing development or areas affected by natural disasters, showcasing the practical applications and benefits of our approach.

2 Our Approach

Crowdsourced Streetview's architecture consists of several key components, but primarily comprises of keypoint matching, as illustrated in Figure 2. The image collection module gathers geotagged images from social media platforms using relevant hashtags and EXIF data. This allows the system to identify user-contributed images that are likely to be relevant to specific locations within the Streetview dataset and match against nearby imagery.

The image alignment component employs homography algorithms from the OpenCV library to accurately align the crowdsourced images with the existing Streetview data. This process

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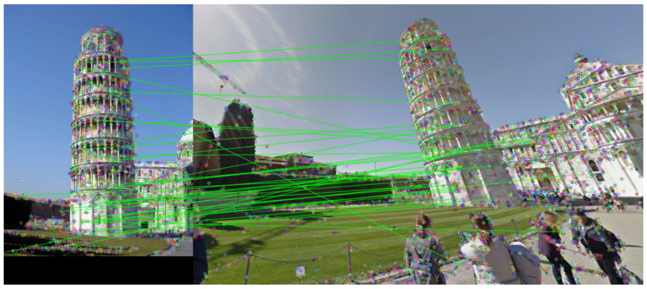

Figure 2. Matching features for proper placement and perspective warping using keypoints.

involves detecting and matching key features between the user-contributed image and the corresponding Streetview panorama. By leveraging optimized feature detection algorithms, such as MagicLeap's SuperPoint, and hardware acceleration through NVIDIA's TensorRT library, the system achieves real-time performance with an image alignment runtime of just 19ms per image pair.

Once the crowdsourced image has been aligned with the Streetview data, the overlay component integrates the new visual information into the existing panorama live and with the proper perspective. This process ensures that the updated imagery is properly positioned and blended with the surrounding context, providing a coherent and up-to-date representation of the location.

Finally, the display module presents the updated Streetview imagery to users, allowing them to explore the enhanced panoramas through the familiar Streetview interface. By continuously integrating new crowdsourced images as they become available, Crowdsourced Streetview ensures that users have access to the most current and accurate visual information for any area.

3 Evaluation and Discussion

To evaluate the performance of Crowdsourced Streetview, we conducted both quantitative and qualitative assessments of the system. Table 1 presents a comparison of the image alignment runtimes achieved by our approach using different feature detection algorithms. By leveraging optimized algorithms and hardware acceleration, Crowdsourced Streetview achieves a significant speedup compared to traditional methods, with TensorRT-accelerated SuperPoint feature detection enabling real-time performance, enabling us to update a user's browser live with relevant crowdsourced imagery.

Algorithm	Runtime
TensorRT SuperPoint	19ms
SuperPoint	4.93s
SIFT	43m

Table 1. Image Alignment Performance Comparison

Qualitative evaluations were performed by visually inspecting the updated Streetview panoramas generated by our system. Figure 1 presents examples of Crowdsourced Streetview integrating user-contributed images into existing Streetview data. These results demonstrate the system's ability to accurately align and overlay new imagery, providing users with up-to-date visual representations of the depicted locations.

Figure 3. Crowdsourced imagery and Google Streetview imagery are combined to create Crowdsourced Streetview.

Our system demonstrates the feasibility and potential benefits of integrating real-time crowdsourced imagery updates into Google Streetview. By leveraging the vast amount of user-generated visual data available on social media platforms, Crowdsourced Streetview can provide more current and accurate representations of rapidly changing environments, especially those affected by disaster, as we can note by a combination of crowdsourced disaster imagery and Google Streetview by Figure 3.

However, there are several limitations and challenges associated with the current implementation of Crowdsourced Streetview. The quality and relevance of the crowdsourced images can vary significantly, potentially affecting the accuracy and coherence of the updated panoramas. Future work could explore image filtering and content moderation techniques to ensure only the most pertinent and reliable user-contributed data is integrated.

Additionally, the scalability of the proposed approach may be a concern when dealing with the massive amounts of imagery data available on social media platforms. Further research into distributed processing architectures and advanced data management strategies could help address this issue and ensure that Crowdsourced Streetview can effectively handle large-scale, real-time updates with thousands of photos, rather than a sample few.

Despite these challenges, the successful integration of real-time crowdsourced imagery updates into Google Streetview has the potential to revolutionize the way we interact with and understand our environment through digital mapping technologies. By providing users with up-to-date, dynamic visual representations of the world around them, Crowdsourced Streetview can enable new applications and insights in areas such as urban planning, emergency response, and virtual tourism.

By continuing to refine and expand the capabilities of Crowdsourced Streetview, we aim to contribute to the advancement of digital mapping technologies and enhance our understanding of the dynamic world around us on a real-time basis.

References

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