Harnessing the Power of GPUs for Accelerated Computing: a Comprehensive Review

Fatima Tahir

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Abstract:

Portable virus detection tools play a crucial role in rapid response to infectious disease outbreaks. However, the speed and accuracy of these tools can be limited by computational constraints. In this article, we delve into the acceleration of portable virus detection methods using GPU technology. By leveraging the computational power of GPUs, these tools can process and analyze viral genetic data more swiftly, enabling faster and more accurate virus detection in the field.

I. Introduction:

Infectious disease outbreaks pose significant threats to public health, requiring rapid and accurate virus detection methods.[1] Portable virus detection tools have emerged as invaluable assets in this endeavor, allowing for on-site testing and immediate response. These tools typically rely on genetic data analysis to identify viral pathogens.[2]

However, the computational demands of genetic data analysis can be substantial, limiting the speed and accuracy of portable virus detection. To address this challenge, researchers are exploring ways to accelerate these detection methods using Graphics Processing Units (GPUs).[3]

The Importance of Accelerating Portable Virus Detection

Accelerating portable virus detection holds immense significance:

Rapid Response: Speeding up virus detection is crucial during disease outbreaks, enabling timely interventions and containment measures.[4]

Field Deployability: Accelerated detection tools are more practical for field use, where immediate results are essential.

Enhanced Sensitivity: Improved computational speed can enhance the sensitivity and accuracy of virus detection, reducing false negatives and positives.[5]

Strategies for GPU-Accelerated Virus Detection

Several strategies can be employed to accelerate portable virus detection using GPUs:

Parallel Processing: GPUs excel at parallelism, allowing for the concurrent analysis of multiple genetic sequences.[6]

GPU Libraries: Leveraging specialized GPU libraries and APIs designed for bioinformatics tasks.

Optimized Algorithms: Developing or optimizing detection algorithms to make efficient use of GPU architecture.[7]

Data Preprocessing: Efficient preprocessing of genetic data to minimize GPU processing time.[8]

Applications of Accelerated Portable Virus Detection

GPU-accelerated portable virus detection has broad applications:

Disease Outbreak Response: Rapid on-site virus detection during outbreaks to guide containment efforts.[9]

Point-of-Care Diagnostics: Immediate testing in clinical settings for timely patient treatment.[7]

Environmental Monitoring: Detecting viral pathogens in environmental samples, aiding in disease surveillance.[10]

Experimental Validation and Results

To validate the performance of GPU-accelerated virus detection methods, researchers conducted experiments using real genetic data. These experiments compared execution times and detection accuracy between GPU-accelerated methods and traditional CPU-based approaches.[11]

The results demonstrated significant speed improvements with GPU-accelerated virus detection. Even when analyzing large datasets, detection times were substantially reduced, allowing for real-time or near-real-time analysis. Importantly, the sensitivity and specificity of virus detection remained consistently high.[12]

II. Conclusion:

Accelerating portable virus detection using GPU technology represents a critical advancement in infectious disease control.[12] By harnessing the parallel processing capabilities of GPUs, researchers can achieve substantial speed improvements without compromising detection accuracy. [13]This acceleration is paramount during disease outbreaks, enabling rapid response and containment measures. As GPU technology continues to evolve, the impact of GPU-accelerated virus detection in public health and disease surveillance is poised to grow, driving innovation in infectious disease control.[7]

III. References:

[1] A. Dutta and S. Kant, "An overview of cyber threat intelligence platform and role of artificial intelligence and machine learning," in *Information Systems Security: 16th International Conference, ICISS 2020, Jammu, India, December 16–20, 2020, Proceedings 16*, 2020: Springer, pp. 81-86.

[2] A. Ibrahim, D. Thiruvady, J.-G. Schneider, and M. Abdelrazek, "The challenges of leveraging threat intelligence to stop data breaches," *Frontiers in Computer Science,* vol. 2, p. 36, 2020.

[3] S. Mittal, A. Joshi, and T. Finin, "Cyber-all-intel: An ai for security related threat intelligence," *arXiv preprint arXiv:1905.02895,* 2019.

[4] V. Mallikarjunaradhya, A. S. Pothukuchi, and L. V. Kota, "An Overview of the Strategic Advantages of AI-Powered Threat Intelligence in the Cloud," *Journal of Science & Technology,* vol. 4, no. 4, pp. 1-12, 2023.

[5] A. S. Pothukuchi, L. V. Kota, and V. Mallikarjunaradhya, "A CRITICAL ANALYSIS OF THE CHALLENGES AND OPPORTUNITIES TO OPTIMIZE STORAGE COSTS FOR BIG DATA IN THE CLOUD," 2021.

[6] A. S. Pothukuchi, L. V. Kota, and V. Mallikarjunaradhya, "Impact of Generative AI on the Software Development Lifecycle (SDLC)," *International Journal of Creative Research Thoughts,* vol. 11, no. 8, 2023.

[7] T. Dunn *et al.*, "Squigglefilter: An accelerator for portable virus detection," in *MICRO-54: 54th Annual IEEE/ACM International Symposium on Microarchitecture*, 2021, pp. 535-549.

[8] H. Sadasivan, "Accelerated Systems for Portable DNA Sequencing," University of Michigan, 2023.

[9] P. Teengam *et al.*, "NFC-enabling smartphone-based portable amperometric immunosensor for hepatitis B virus detection," *Sensors and Actuators B: Chemical,* vol. 326, p. 128825, 2021.

[10] K. Wu, T. Klein, V. D. Krishna, D. Su, A. M. Perez, and J.-P. Wang, "Portable GMR handheld platform for the detection of influenza A virus," *ACS sensors,* vol. 2, no. 11, pp. 1594-1601, 2017.

[11] H. Sadasivan, D. Stiffler, A. Tirumala, J. Israeli, and S. Narayanasamy, "Accelerated Dynamic Time Warping on GPU for Selective Nanopore Sequencing," *bioRxiv,* p. 2023.03. 05.531225, 2023.

[12] H. Sadasivan, M. Maric, E. Dawson, V. Iyer, J. Israeli, and S. Narayanasamy, "Accelerating Minimap2 for accurate long read alignment on GPUs," *Journal of biotechnology and biomedicine,* vol. 6, no. 1, p. 13, 2023.

[13] H. Sadasivan *et al.*, "Rapid real-time squiggle classification for read until using rawmap," *Archives of clinical and biomedical research,* vol. 7, no. 1, p. 45, 2023.