

Performance Improvement of Hybrid Content Based Image Retrieval

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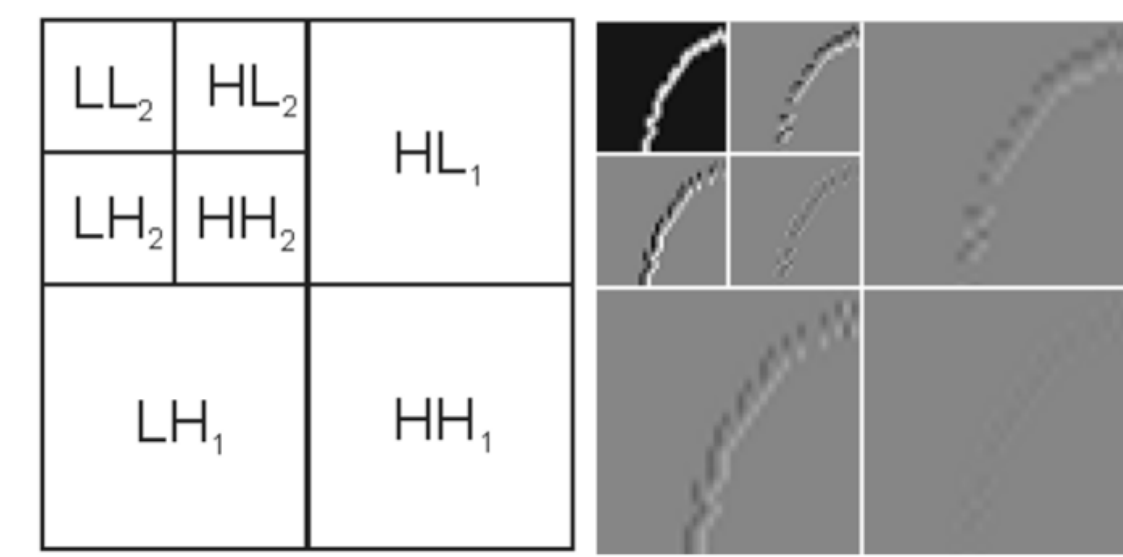
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Abstract

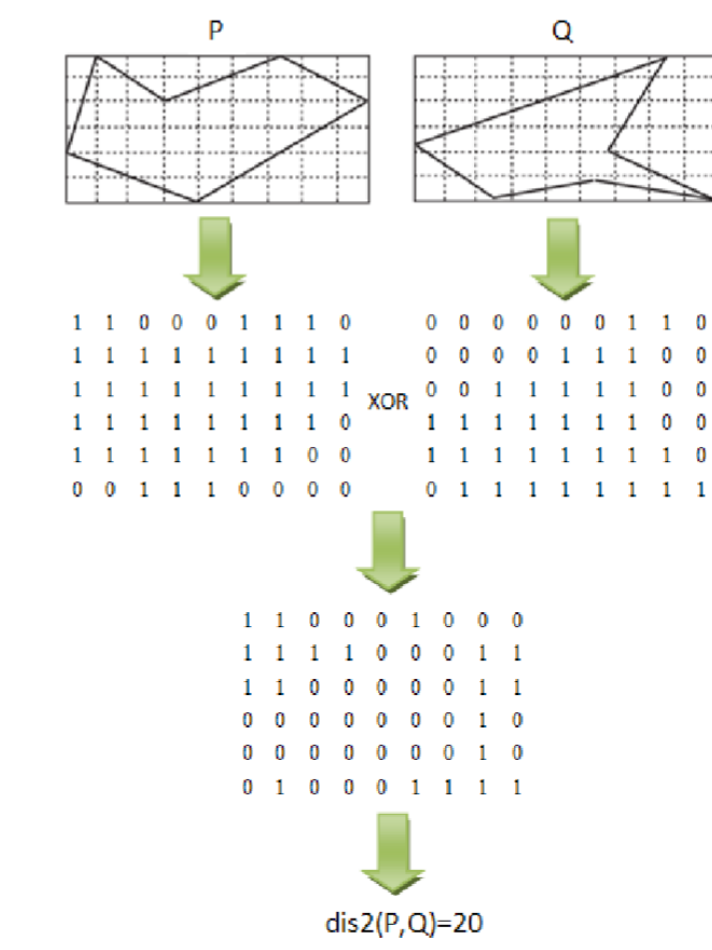
A Hybrid approach in Content Based Image Retrieval (CBIR) provides higher accuracy as compared to a global approach but at the same time it comes with the high computational complexity of the local approach. Our implementation of the hybrid CBIR system has reduced complexity and better performance than the original approach, using various methods such as caching, parallelism, map-filter, approximation and reducing comparisons. Our results indicate that the performance can be improved by a huge margin without sacrificing accuracy.

Feature extraction & Similarity



2D DWT

XOR



Global Similarity

$$dis2(P,Q) = \Sigma(\text{number of ones after Xor operation})$$

$$disGlo(P,Q) = \frac{dis2(P,Q)}{dis2(F,Q)}$$

Local Similarity

$$dis1(P,Q) = \sum_{i=1}^{16} ||V_i^P - V_i^Q||$$

$$disLoc(P,Q) = \frac{dis1(P,Q)}{dis1(E,Q)}$$

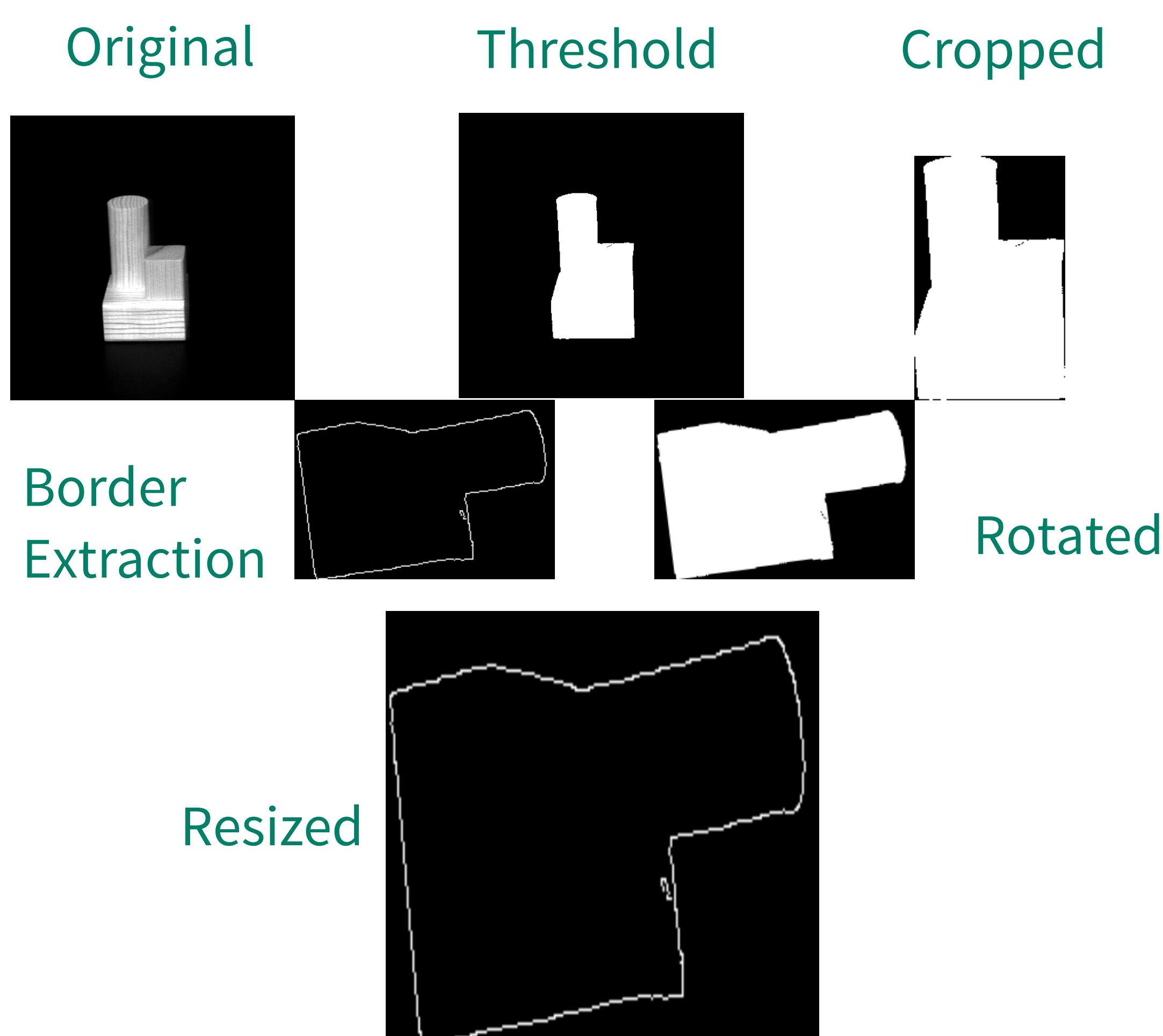
Total Distance

$$dis(P,Q) = \frac{disLoc(P,Q) + disGlo(P,Q)}{disLoc(G,Q) + disGlo(G,Q)} * 100$$

Optimizations

1. Caching - MongoDB
2. Reducing Loops.
3. Parallelization and multicore processing.
4. Optimizing loops.
5. Reducing data size.
6. Junking lower values.
7. Reducing unnecessary computations.
8. Using GPU to speed up the system.
9. Map - Filter - Reduce to optimize search.

Pre-processing



The System

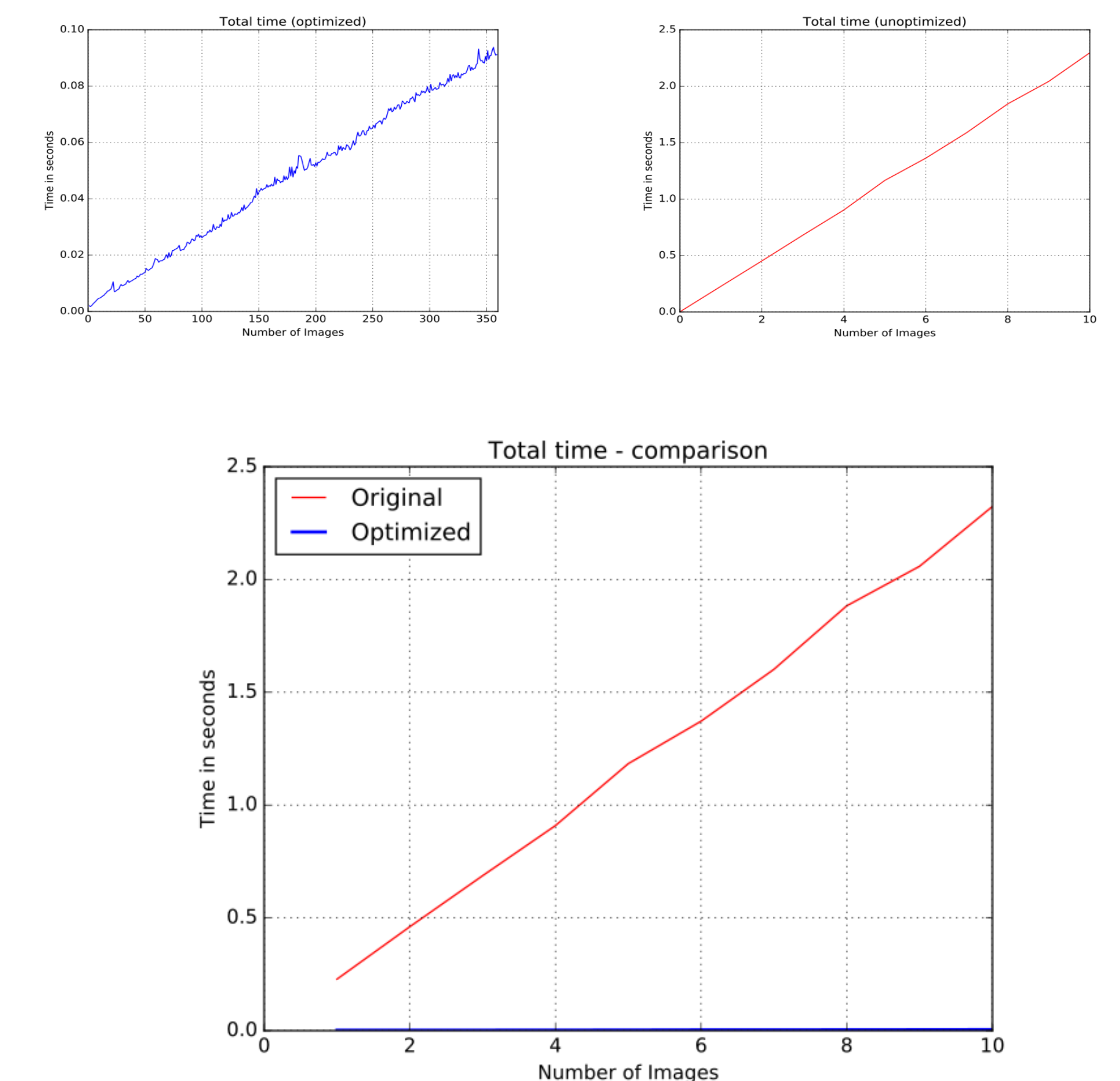
Local Feature Extraction :

1. Area division - 16 equal parts.
2. 2D - Discrete Wavelet Transform.
3. Singular Value Decomposition of child block.

Similarity Measurement :

1. XOR for global features.
2. Taxicab Norm for local features.
3. Normalization with highest value.
4. Divide each distance by the maximum distance to find the %age similarity.

Performance Evaluation



The System

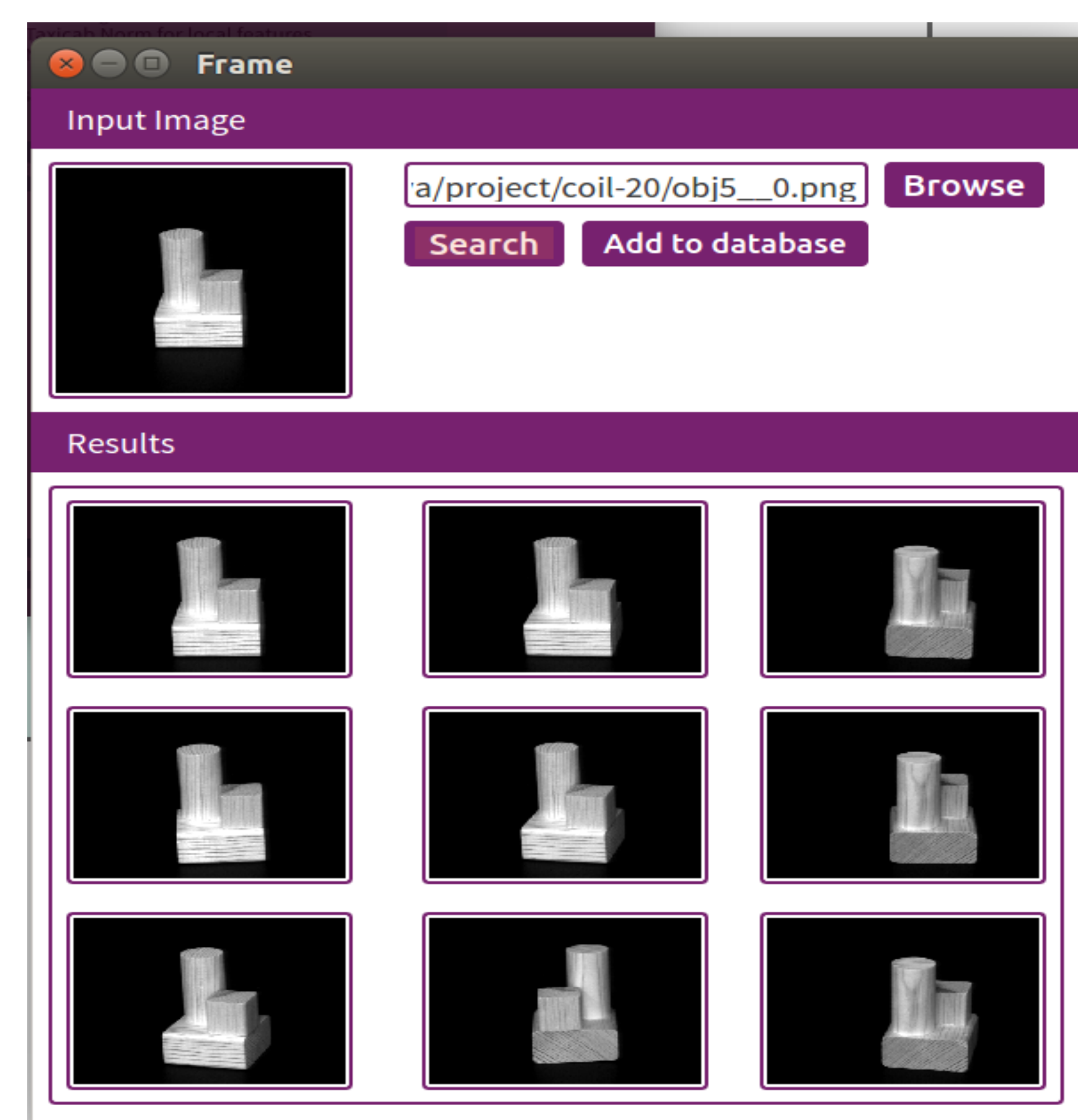
The following operations are carried out to make the image - scale, rotation and color invariant.

1. Foreground Extraction
2. Cropping
3. Rotation
4. Border Extraction
5. Resizing

Global Feature Extraction :

1. Grid shape representation is used to create a binary matrix representing the image.

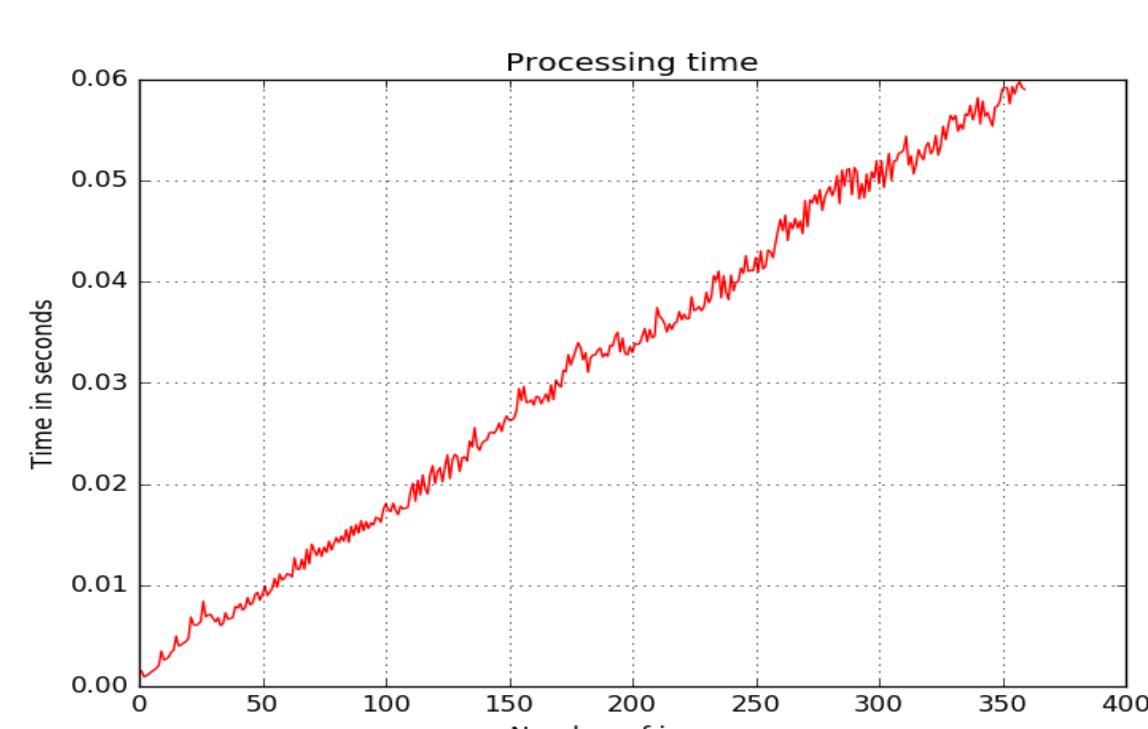
Graphical User Interface



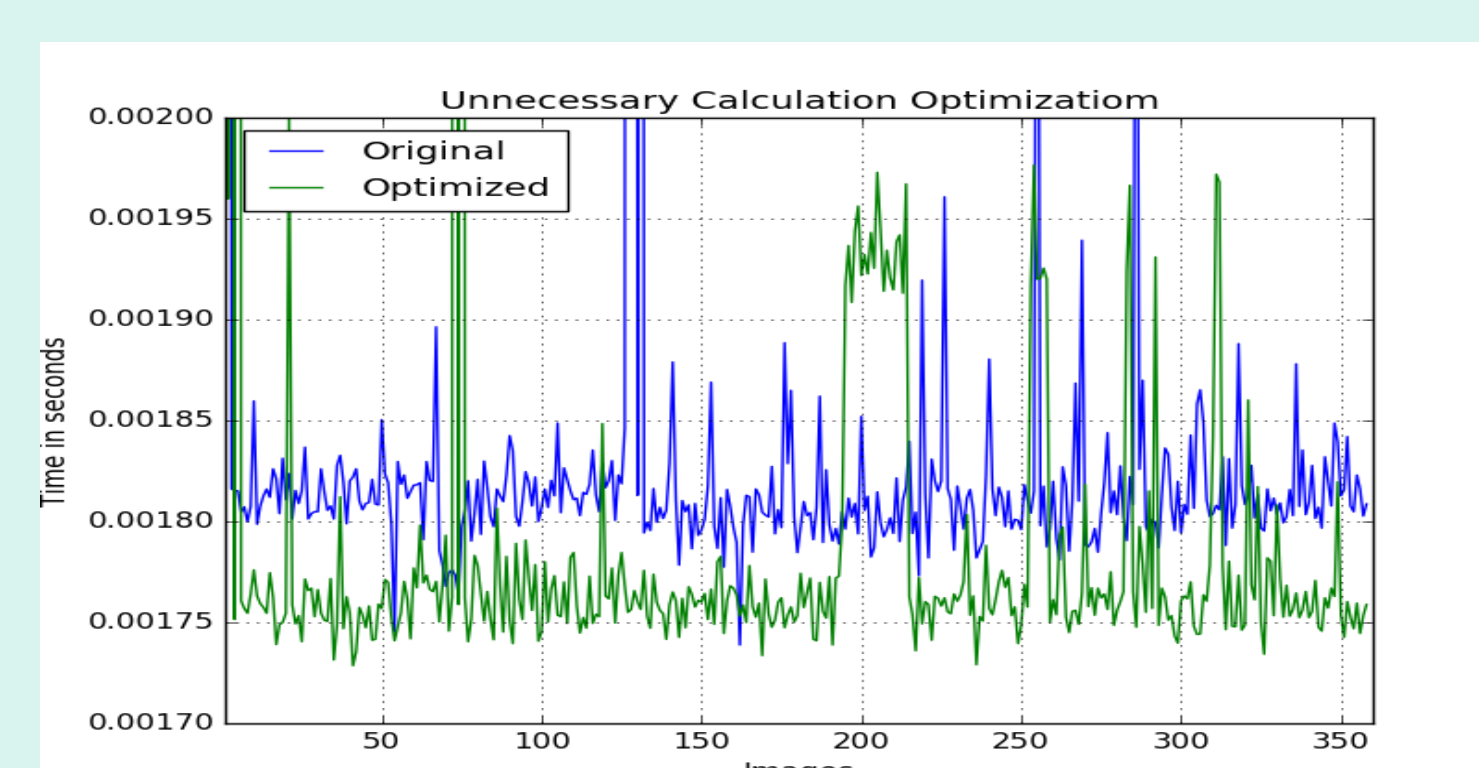
Results

1. Image retrieval with very high accuracy.
2. Database and caching improve the performance several times over the original implementation without affecting accuracy.
3. Multi core processing, and other optimizations improve processing significantly over basic implementation.
4. Map-filter can improve performance significantly while slightly reducing accuracy.

Linear Scaling



Unnecessary Calculations



Map - Filter

