Overview Apprach:

This algorithm involves taking a fingerprint template and divide the fingerprint into grids of size y and the amount of grids being size x. After diving into X amount of square grid segments of size Y, each grid will be numbered for distinguishability from 0-X.
The next process will envolve processing the entire fingerprint for an initial base minutiae detection, only ends and bifurications. From there, each square segment labled 0-X will be given an attribute of the amount of basic minutiae present within each square, and the coordinate locations of each grid in perspective of the entire fingerprint will be stored
After this, the grids minutiae density above the global average will selected as “high-density.” This leaves, for simplicity, 2/X remaining square grid segments left. Within each grid, an algorithm for a more advanced minutiae detection approach will be implemented. These methods may include: minutiae triplets, local structures, or extra minutiae. From the chosen method a matching score will be generated and will be unique to the fingerprint.

Identification Applications:

For identification, I feel that this algorithm may be more suited for. With the above approach, we can use a proposed cascade approach, taken from a Viola-Jones facial recognition paper study. With the cascade approach, we take a 1:M (one to many) process where we have one template and compare the template to the many templates of a large database.

1. The first cascade level would be to gather global high-density grid segment location coordinates. We compare the high-density coordinates of the template with the coordinates of each of the database’s templates.
2. The second cascade level would be gathering the mintaue within each grid and ridge frequency within these grids and comparing the template across the many.
3. The third cascade level would be an extension of this
4. The fourth cascade level would be comparing global matching scores, local matching scores, local structures, etc

In using the cascade approach with the high density grid segmentation, we would dramatically decrease the target pool with each cascade level and significantly improve overall performance.

How this would work:
1. The system would take in an enhanced fingerprint image, then divide the fingerprint image into grids numbered from 0-X where X is the total number of grids. The number labels on each grid will be a critical part for high-density segment distinction later on. The number of grids will need to be consistent across the entire system, stored data and the probed fingerprint (the fingerprint trying to be identified).
2. From there the system would then extract all the basic minutiae data within the entire fingerprint, and track the number of minutiae within each 0-X segment. After collecting each

segment's number of minutiae, average the number of minutiae present in each segment (example: if the total number of minutiae 100 minutiae points, there would be 100/X minutiae points per segment on average) and apply a threshold that will only allow the further processing of segments that hold above a certain amount of minutiae. The segments that remain should hold above the average amount of minutiae, hopefully reducing the amount of segments by well over half the original segments (this process of averaged and reduction could be repeated if the overall amount of remaining segments are too many). The remaining segments will be the high-density segments.

3. The next step would be for the system to apply further advanced minuaie data extraction on the remaining high-density segments, the method of choice should be minutiae triplets, unless a better alternative is given. A triplet is a set of three minutiae points, which together form a unique pattern based on their relative positions and angles. The choice of triplets is significant because it allows the matching process to focus on the structural relationships between minutiae points, which are less likely to be affected by partial prints, distortions, or common fingerprint features across different individuals.

4. This step starts the actual identification process, the previous steps are for the probe fingerprint pre-processing. The system will take the labeled high-density segments and compare the labels to the labels of which are in the database of stored fingerprints. For example, lets say there are only 9 total segments of the fingerprint labled as segment 0 through segment 8 from left to right, and top to bottom (there should be much more to be practical). If the probe high-density segments are segments [2,6,9], the system would filter out all candidate fingerprints from said database who's high-density segments are NOT [2,6,9], leaving only the remaining fingerprints that have the same high density segments as the probe fingerprint.

5. The next step compares the extracted triplet data from each of the probe's high-density segments, to those of the remaining candidate fingerprints in the database. So the probe's segments would have triplet data1 from segment 2, triplet data2 from segment 6, and triplet data3 from segment 6. This triplet data from the probe will be compared against the remaining candidates, so the probe's data1 from segment 2 will be compared against candidate #1's data1 from its segment 2, and the probe's data2 from segment 6 will be compared against candidate #2's data2 from its segment 6, and so on. This process would repeat for each remaining candidate from the first filtering process and will get a matching score from each probe to candidate comparison, and the best matching score would result in the match for the probe.