application with low computational complexity and low power consumption. This work can be extended with increasing the database for further verification.

Bin et al. [2] discusses liveliness detection method based on an optical measurement for sequence infrared images. The vein images are related with vital signs such as oxygen saturation in human blood and heart rate. Two kinds of different algorithm are used for feature extraction, one for vital signs detection, the other for identification. In the algorithm the feature-similarity degree threshold are defined as p1 and p2. If the feature-similarity degree p of two images from continuous sampling is great than p1, the two images are marked sameness. If p is less than p2, the two images are marked independence. This method can prevent the identification spoofing and improve the security capability of vein identification system. Applying the above stated algorithm, an improved system can be easily built up that fake vein registration, rapid finger vibration, false blood fluidity cannot pass the examination.**Cao et al.** [3] proposed a new finger vein image matching method based on structure feature. To describe the finger-vein structures conveniently, the vein skeletons are firstly extracted and used as the primitive information. Based on the skeletons, a curve tracing scheme depended on junction points is proposed for curve segment extraction. Next, the curve segments are encoded piecewise using a modified included angle chain, and the structure feature code of a vein network are generated sequentially. Finally, a dynamic scheme is adopted for structure feature matching.

Indu et al. [4] proposed a novel finger vein feature extraction technique. In this paper, there are two main steps: image processing and feature extraction. The aim of image preprocessing is to enhance some image features relevant for further processing task. As a result, interesting details in the image are highlighted and noise is removed from the image. The finger vein images are preprocessed by applying morphological operations and is enhanced based on the concept of local histogram equalization. Then relevant features are extracted.

Hejtmankova et al. [5] describes a new method for finger vein detection. This method is split into four parts. The first of them consists of basic series of image filters enhancing the vein pattern itself and the other three are sequences of image filters determining the finger contour used for the background masking. The tests were done and their experimental results show a great potential of the proposed method. In future work enhancements can be done to this proposed method. The first is to reduce the template size in order to lower the computational cost and memory requirements. The next improvement is the speed up of database searching.

Jandrotia et al. [6] proposes a new approach for person verification with the help of finger vein. The proposed system simultaneously acquires finger vein and low resolution finger images and combine these two evidences using a novel score -level combination strategy. Gabor filter and repeated line tracking are combined together to develop new approach.

Miura et al. [7] proposes a feature extraction method based on repeated linetracking . This method extracts the finger-vein pattern from the unclear image by using line tracking that starts from various positions. Local dark lines are identified,and line tracking is executed by moving along the lines,pixel by pixel. When a dark line is not detectable, a new tracking operation starts at another position. This method is far superior to the conventional method based on a matched filter. Further experiments showed that the equal error rate was 0.145% and the response time was 460 ms, which means the method is very effective as a means for personal identification. The problem with the method was that noise may also get tracked while executing the repeated line tracking.

Prabhakar et al. [8] discusses approach to perform finger vein identification based on extracting minutiae features and spurious minutiae removal. Minutiae feature extraction includes the extraction of end points and bifurcation points from the skeletal patterns of vein and the removal of spurious or false minutiae. The presence of false minutiae can disturb the comparison of two biometric samples and it affect seriously at the time of matching. Presence of spurious minutiae is a serious issue in the identification process and it should be removed. False minutiae can be eliminated by distance based method and boundary elimination.

Prabhjot et al. [9] proposes an enhanced human identification algorithm using finger vein which is based on repeated line tracking , Gabor filter and automatic trimap generation. Fingervein detection using repeated line tracking or gabor filter could not provide better results. But this enhanced algorithm is more accurate and with low cost as compared to human identification using finger vein technique.

Prasad et al. [10] proposes a real time embedded finger vein recognition system for authentication on mobile devices . The system is implemented on embedded platform and equipped with a novel finger vein recognition algorithm. The results are evaluated and EER is reduced to 2.36% in proposed system as compared to conventional system as EER is 38.4%.

3. Finger Vein Recognition System

The flow diagram of proposed work is as follows:

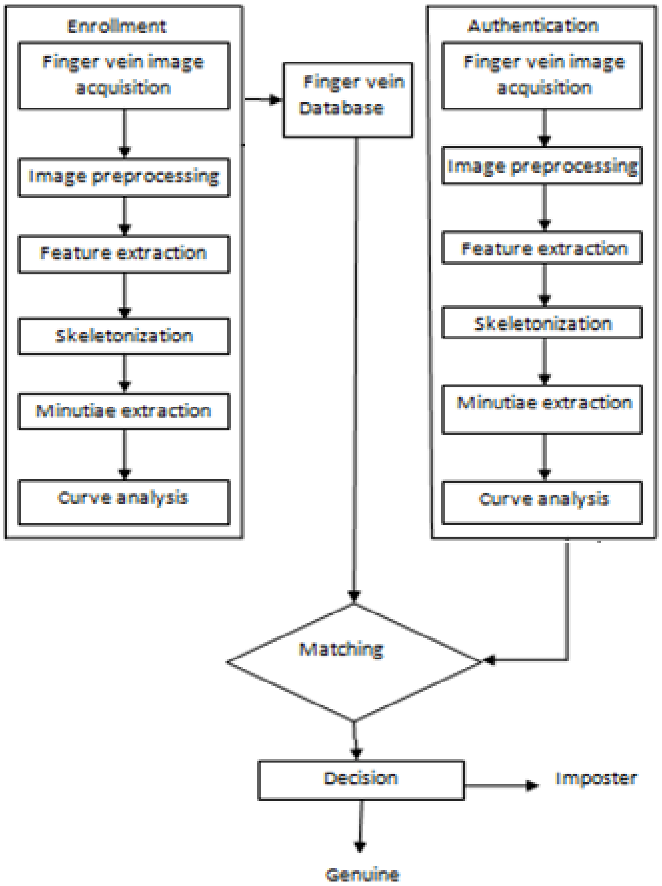

Figure 1: Flow Chart Of Proposed Work

The algorithm used for finger vein image matching method:

a) Step 1: Image Acquisition
- Step a: Acquire test image
- Step b: Acquire training images one-by-one and apply following tasks in iterative fashion

b) Step2: Test and Training image pre-processing
- Step a: Compute grey-threshold
- Step b: Binary Conversion
- Step c: Obtain the boundaries of the hand

c) Step3: ROI Extraction
- Step a: Rotate the picture
- Step b: Obtain the center of the finger
- Step c: Set (x1, y1) and (x2, y2) values
- Step d: Extract Region of Interest (ROI)

d) Step 4: Apply Region growing technique for feature specification
- Step a: get seed pixel i.e. starting pixel
- Step b: For every pixel in image
- Step c: Find shortest distance between neighboring pixel using distance formula
- Select d: Select pixel with shortest distance in the region

e) Step 5: Extract Minutiae Points
- Step a: Apply thinning technique to extract the finger-vein skeleton
- Step b: Compute the minutiae points
- Step c: Coordinates of intersection Points (Minutiae coordinates)

f) Step 6: Apply curve analysis over the minutiae point information
- Step a: Apply calculus methods to obtain the curves
- Step b: Find and count the lines or the curves connecting two point
- Step c: Find the amplitude, phase and actual curve length

g) Step 7: Return the matching finger-vein sample and Recognize the person
- Step a: Match the curve details with training data
- Step b: Show the match with highest similarity as the recognized sample
- Step c: Find the person ID and correlate the person recognition.

4. Results and Discussions

SDUMLA-HMT a finger vein database is the first open finger vein database. The device used to capture finger vein images is designed by Joint Lab for Intelligent Computing and Intelligent Systems of Wuhan University. The SDUMLA-HMT contains (size 0.85 GB). From this database 5 images of left finger of 20 individuals is selected which is under normal condition. Images taken in the database are grey scale. A colored finger vein image if given as input test image is to be first converted to grey scale image as grey scale images are easier for applying computational techniques in image processing. Matlab 2013a is used for coding. All the images in our database are of same size i.e. 320×240. Every image is stored in "bmp" format.

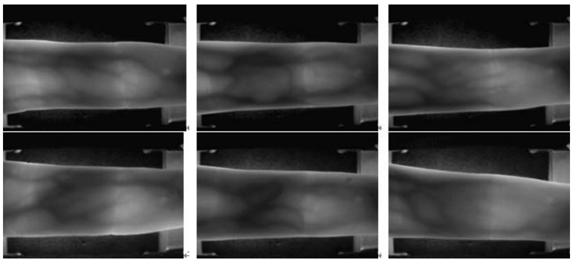

Figure 2: Some of Datasets from Database

Based on the experiment performed the values of parameter FAR and FRR are calculated. . The results are as follows:

Table1: Values of FAR and FRR

Index	FAR	FRR	Accuracy
1	0.16	0	92%
2	0.2	0.02	89%
3	0.29	0.022	82.4%
4	0.25	0	86.4%
5	0..14	0.023	91.85%

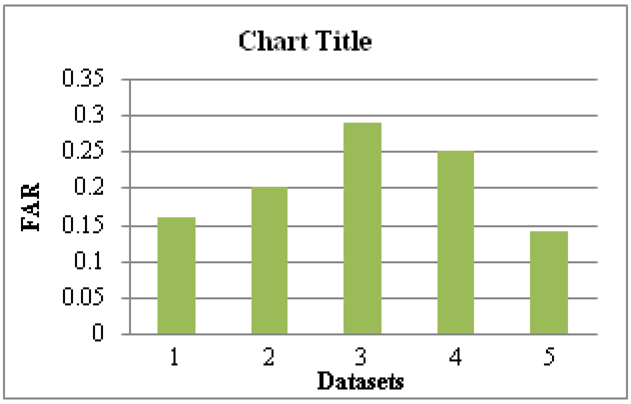

Figure 3: Graph of FAR

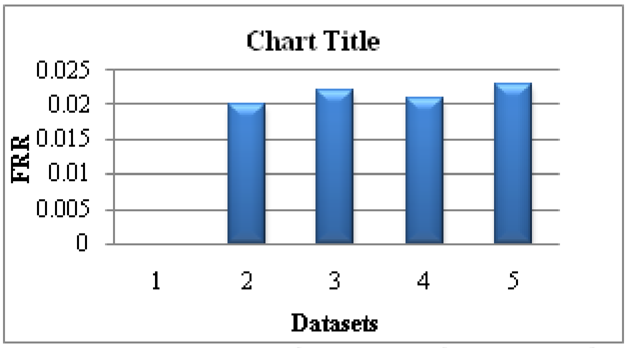

Figure 4: Graph of FRR (False Rejection Rate)

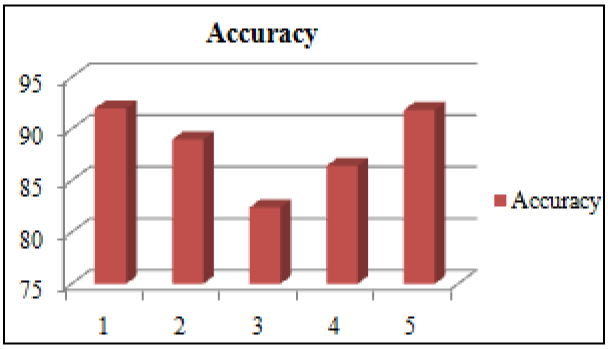

Figure 5: Graph of Accuracy

5. Conclusion

In this research, the research model for the finger vein extraction has been designed and developed. The proposed model has been developed using the combination of minutiae point extraction along with curve analysis has been used in the proposed model. The accuracy around 94% has been achieved using the proposed model. The very less equal error rate has been recorded from the proposed model results at 0.005. The proposed model has performed better in all contexts from the previous models.

6. Future Scope

In the future, the proposed model can be enhanced using different methods for extracting the minutiae points or vein curves or imaginary curves between the minutiae points. The proposed model can be compared with the other existing models in order to analyze its performance on the basis of several parameters.

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