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Literature Review

Biometric Iris Recognition System's Software and Hardware Implementation Using Lab VIEW tool

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Abstract

In this paper, the software implementation of the automatic biometric iris recognition system using the proposed methodologies under unconstrained environments is being presented with the proposed block-diagrams developed in the LabVIEW environment. 3 different contributions are presented here in this paper, which is a part of the research work undertaken by the research scholar. It also describes the various steps that are used in the proposed methodologies and all the basic blocks involved in the design process of each contribution. In order to achieve the better accuracy, performance and error rate than the existing methods done by earlier researchers, 3 different iris recognition system techniques under unconstrained environments have been proposed which involves different feature extraction techniques and matching or classification algorithms and some of them being compared with the earlier works done by other researchers, thus establishing the supremacy of the work done by us. Matlab tool is used for the software implementation purposes due to its add-on features and support provided. Codes are developed in the LabVIEW environment as .vi files. The developed .vi files are run; the simulation results are observed and the discussion on the simulation results are presented for each contribution. Finally, the overall conclusions are drawn on the observation of all the 3-contributory works. Hardware implementation using a Micro-controller is also proposed in this paper, which has yielded very good results. A number of algorithms for iris recognition has been designed in the proposed research work which is being presented in a abstracted manner in this research paper.

Keywords: Biometrics; Iris; Authentication; Recognition; Identification; Classifiers; Simulation; Matlab; LabVIEW; Neural Network; Database; Image; Pre-processing; Segmentation; Algorithm; Histogram; Filter; Edge Detection; Normalization; Wavelets; Coding; GUI; Unconstraints; Constraints; Hardware; Software; Implementation

Organization of this Research Paper

The paper is organized as follows. A brief introduction about the iris recognition systems is presented in section II followed by the exhaustive summary of the research works presented by various authors in the form of a literature survey in section III. The section IV presents the drawbacks of the works done by the various authors/researchers in the field of biometrics. Section V presents the steps for image analysis and the algo that is being developed by us. Summary of the different iris recognition processes used in the image processing arena related to the work is being presented in section VI. Introduction to LabVIEW is being presented in section VII followed by the brief block-diagrammatic approach of the proposed 6 contributory works in section VIII. The section IX concludes the paper with conclusions followed by the references [1-30].

Introduction Remarks

In this research work, the iris recognition system has got 2 levels, viz.,

- The registration phase: the iris enrollment section and
- The verification phase: the iris recognition section.

Note that in both the above mentioned 2 phases, viz., the registration phase and the verification phase, the template of the iris scan image to be verified is compared with the set of iris scan templates in different angles which are stored in the iris databases, that too for the unconstrained environments. Different standard databases are being used for comparision purposes, which are presented in a concise manner in the appendix section at the end of the paper [1-5].

In the modern day computerized world, biometric plays a very important role in the identification of any human being in any type of work-place. Hence, a brief introduction about the research work and its background was presented in the introductory section w.r.t. iris biometric identification, recognition process along with the motivation, problem definition, contributions and the flow of the paper in the earlier section [6-10].

Literature survey (review of the work done by various researchers)

A brief overview of the work done in the relevant field is conducted on the chosen research topic, "Design and development of efficient algorithms for IRIS Recognition system for different unconstrained environments" and the same is presented in the form of an exhaustive literature survey. To start with, a large number of research papers in the relevant field were collected from various sources, studied @ length and breadth and a review paper is being presented in the form of this one such [11-15].

Iris recognition methods have been investigated and developed over the past decade and the most recent implementations have shown very reliable recognition rates under constrained environments. A majority of the previous iris recognition research was focused on the complete and clean iris images. The image quality was supposed to affect the performance of the iris recognition. Less constrained iris identification systems at a distance and moving images suffer from poor resolution and from poor quality of the captured iris images, which significantly degrades the iris recognition performance. The non-ideal iris images are defined to be the iris images with the problems such as acquisition angle, occlusion, and pupil dilation, image blurry and low contrast. Majority of the work were not done in this unconstrained environment context and the same is taken up as the research work under by us in this research paper [16-20].

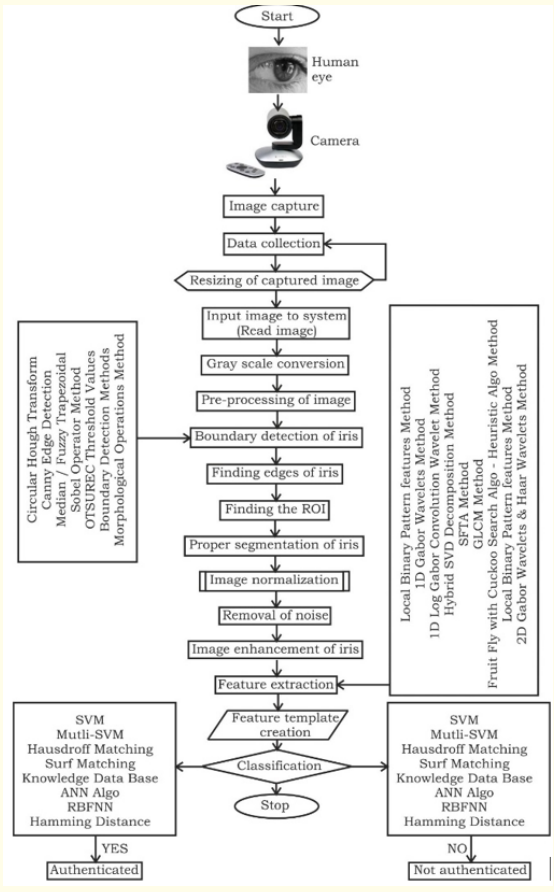

Figure 1: General flow-chart/diagram for the detection of iris in unconstrained environments for the 3 contributions.

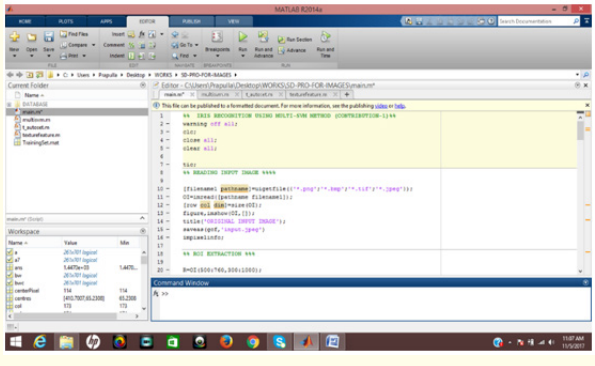

Figure 2: Layout of the Matlab environment.

Drawbacks of the work done by researchers

Many works have been proposed on iris biometric recognition system for secure authentication till date. Majority of the researchers had worked on the recognition systems under constrained environments, in the sense that the camera should be pointing directly towards the eye, the person should be looking directly, there is no parallax, eyes should be wide open to capture the iris, good illumination should be there while taking the picture, etc….. [21-25].

But, very few of them have worked on the iris recognition systems under unconstrained environments, which is the topic of concern in our research work. Even if the algorithms developed in constrained environments work efficiently, they may or may not work efficiently for unconstrained environments. It has to be noted that for unconstrained environments, many constraints need to be kept in mind for proper and accurate functioning of the system, which has been discussed in the earlier papers published by us [26-30].

Steps for the image analysis and recognition algo

Normal step for the enrollment segment begins with iris image acquisition from the high resolution iris camera accompanied via picture segmentation to locate the region of interest (ROI) from the whole image of the person's face. Image acquisition captures the eyes of the human being. It has to be noted that the ROI is only the iris part and only that part has to be taken into consideration.

For the purpose of analysis and to increase the system performance, the original image is pre-processed. Then, normalization procedure is implemented on the pre-processed image in order to lessen the noise and increase the efficiency of the recognized set of rules, followed by the enhancement of the iris part.

Then, the iris features are extracted and saved as a feature vector to make comparison with many other vectors stored in the iris database and so the very last step could be the recognition of the person. The 6 contributory works which uses the concepts of pre-processing, edge detection, segmentation, normalization, feature extraction and classification for the recognition of an iris of any human being are.

Pre-processing (P), Segmentation (S) and Normalization (N) using

- PSN 1: Canny Edge Detection and Circular Hough Transforms
- PSN 2: Hough Transform and Canny Edge Detection
- PSN 3: Fuzzy Trapezoidal and Sobel Operator Method
- PSN 4: OTSU Threshold Values
- PSN 5: Boundary Detection Methods
- PSN 6: Morphological Operators
- PSN 7: Canny Edge Detection Method
- PSN 8: Hough Transforms (Periocular).

Feature extraction (FE) using

- FE 1: Local Binary Pattern Method
- FE 2: Gabor Wavelets
- FE 3: 1D Log Gabor Convolution Wavelet and Hybrid SVD
- FE 4: SFTA Method
- FE 5: GLCM Method and Fruit Fly with Cuckoo Search Algo - Heuristic Algo
- FE 6: Local Binary Pattern Method.

Classification (CN) using

- CN 1: Mutli-SVM
- CN 2: Hamming Distance
- CN 3: Hausdroff Matching and Surf Matching
- CN 4: Knowledge Data Base and Neural Network Algo
- CN 5: RBFNN, Neural Network and SVM
- CN 6: Hamming Distance Method.

The general data flow-diagram for the 6 contributory works is shown in figure 1.

Summary of the different iris recognition process using IP

In general, the complete iris scan recognition system could be summarized as consisting of different blocks with each block having its own functionality and all the blocks are used in our research work.

- Database (general/generated one)
- Image acquisition/capturing
- Gray scale conversion
- Identification of ROI
- Pre-processing
- Re-sizing
- Boundary detection
- Segmentation
- Localization
- Normalization
- Noise removal
- Enhancement
- Feature processing
- Feature extraction

- Feature encoding
- Matching
- Classifiers
- Testing
- Decision taking
- Authentication
- Identification
- Recognition/Matched
- Non-recognition/Un-matched

Introduction to LABVIEW

In this section, different contributory works are carried out in the process of iris recognition using the LabVIEW tool, which is a product of National Instruments NI® An overview of the LabVIEW is presented in the following paragraphs. The LabVIEW layout is as shown in the below figure 2, which consists of a command window, workspace window, main program editor window and the location of the files present in the program. It includes built-in mathematical functions that are fundamental to solving engineering and scientific problems, and an interactive environment ideal for iterative exploration, design, and problem solving for any application oriented work.

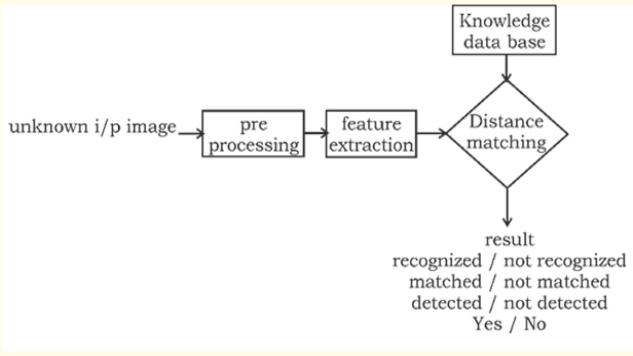

Figure 3: Functional block diagram of the proposed research work.

Contributory works proposed

In this section, the various contributions of the research work are presented below as 3 different entities with C1 to C3 done under LabVIEW environment. The proposed block diagrams have been converted into .vi files (LabVIEW codes) and run. Once, it is run, results are obtained and the answer is yes or no, i.e., iris recognized or not recognized. The 3 contributions in the proposed research work are presented one after the other as follows along with the proposed block-implemented which are implemented.

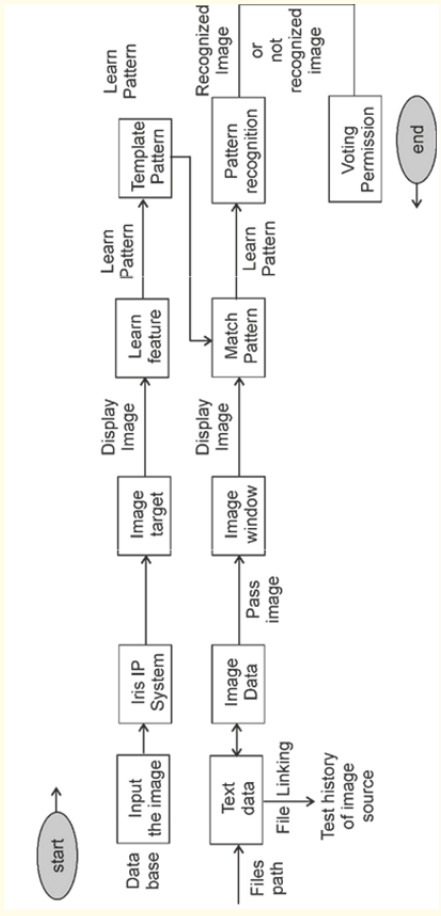

Figure 4: Data flow diagram of the IRS used for voting purposes.

This section concentrates on the step by step execution of the software implementation of the proposed algorithm/s for iris recognition under unconstrained environments, which is associated with a data flow diagram, two methodologies are being proposed in this chapter along with the development of a GUI in LabVIEW. This chapter also demonstrates the various results obtained for all the test images along with the necessary observations and explanations in the form of discussions.

It also describes the various steps that are used in the proposed methodologies and all the basic blocks involved in the design process of each contributions. In order to achieve better accuracy, performance and error rate than the existing methods done by earlier researchers, 2 different efficient iris recognition systems under unconstrained environments have been proposed which involves different feature extraction techniques and matching or classification algorithms.

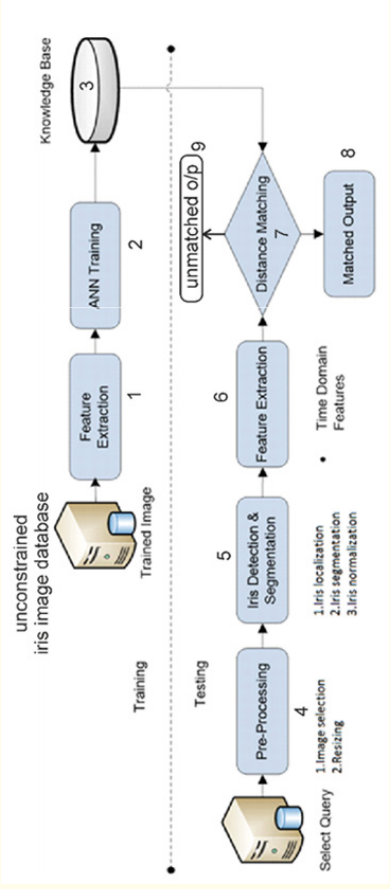

Figure 5: Proposed Iris recognition BD using ANN with LabVIEW tool.

LabVIEW tool is used for the software implementation purposes due to its add-on features and support provided. Codes are developed in the LabVIEW environment as .vi files. The developed .vi files are run, the simulation results are observed and the discussion on the simulation results are presented for each contribution/s. At the end, the hardware implementation of the iris recognition system using a micro-controller is presented. Finally, the overall conclusions are drawn on the observation of all the contributions.

Contribution 1

Iris recognition using the concepts of Pre-processing, Segmentation (Boundary Detection Method using Sobel), Feature extraction (2D Gabor Wavelets and Haar Wavelets) and Classification of iris images (ANN Method) with the development of an automated GUI for iris biometric recognition using the LabVIEW tool.

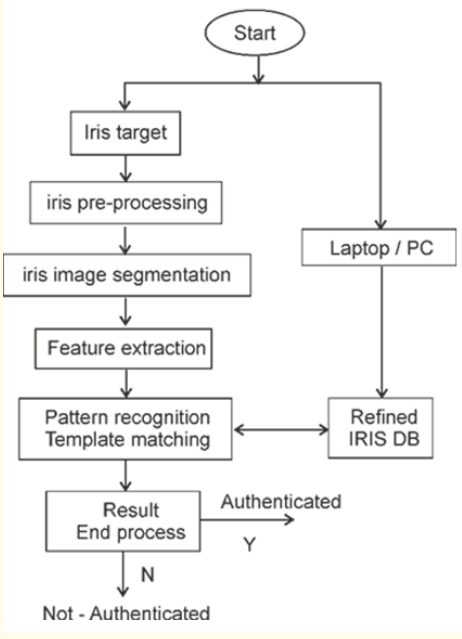

Figure 6: Flow-chart for image extraction (Part-1).

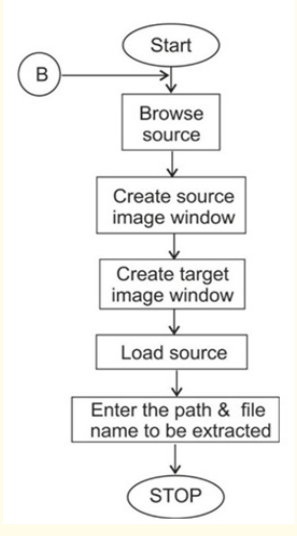

Figure 7: Flow-chart for image extraction (Part-2).

This contributory work involves the development of an interactive iris recognition system for unconstrained images using the concept of Pre-processing, Segmentation (Boundary Detection Method using Sobel Operators), Feature extraction (2D Gabor Wavelets and Haar Wavelets) and Classification of iris images (ANN) with the development of an automated GUI for iris biometric recognition using the LabVIEW tool.

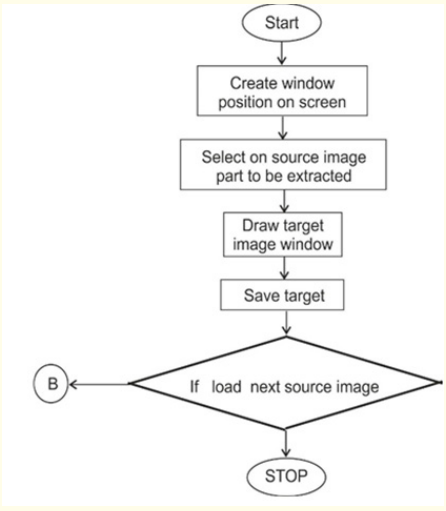

Figure 8: Flow-chart for template matching/pattern recognition (Part-1).

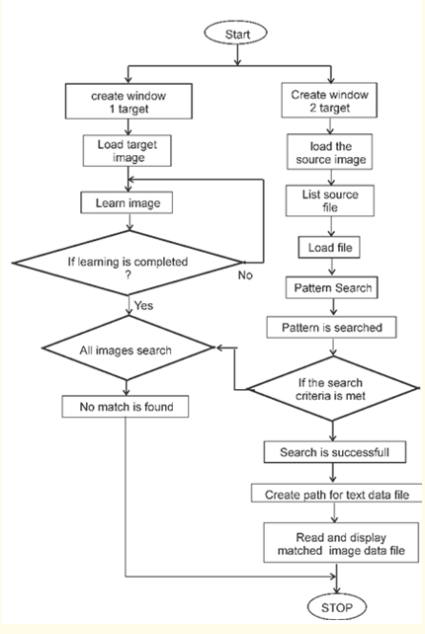

Figure 8: Flow-chart for template matching/pattern recognition (Part-1).

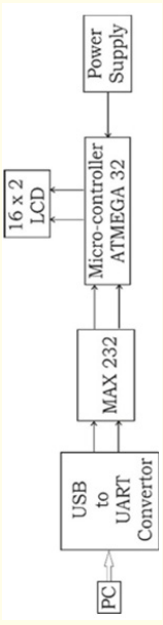

Figure 10: Interfacing of LCD to Microcontroller (Hardware implementation block diagram).

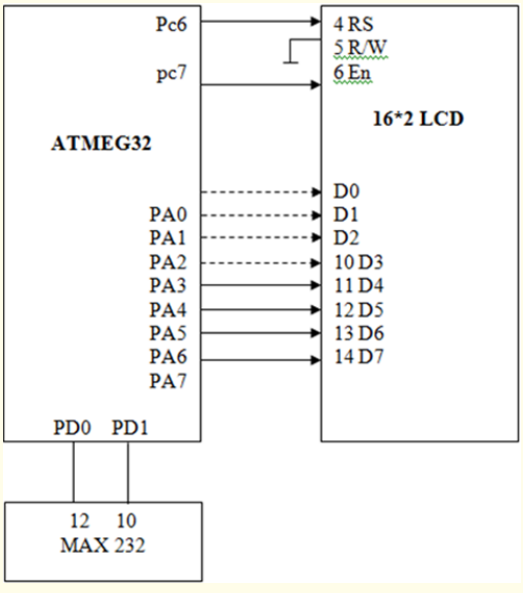

Figure 11: Interfacing of LCD to Microcontroller (Hardware implementation block diagram).

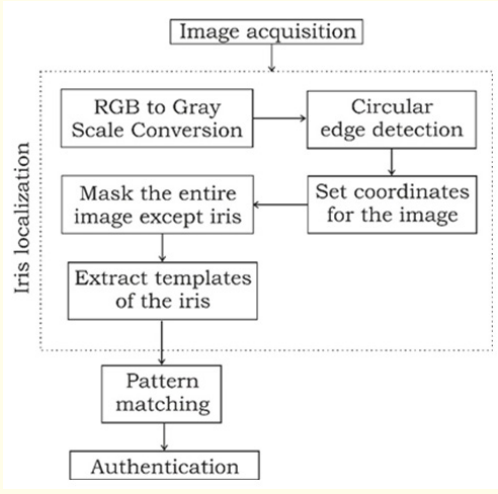

Figure 12: Algorithm for the hardware implementation – I.

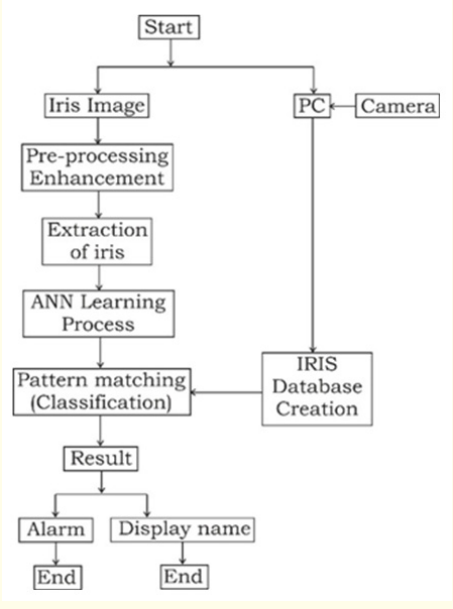

Figure 13: Algorithm for the hardware implementation – II.

Iris recognition system has been implemented using NI Lab VIEW and NI Vision assistant platform. NI LabVIEW is one of the most popular graphical programming languages used worldwide for scientific and engineering activities. NI Vision for LabVIEW - a part of the Vision Development Module - is a library of LabVIEW VI's that one can use to develop machine vision and scientific imaging applications. In this contribution, we also develop a GUI to identify some of the various process of the iris recognition system such as pre-processing, feature extraction, etc…. are being used.

Contribution 2

Application of iris recognition system developed for electronic voting using LabVIEW.

Contribution 3

Hardware implementation of the iris recognition concept using ATMEL micro-controller interfaced with LabVIEW with the development of an automated GUI.

Overall 3 contribution conclusions

In a nutshell, this section concentrates on step by step execution of implementation of the proposed algorithm which is associated with a data flow diagram, one methodology is proposed in this chapter along with the development of a GUI in LabVIEW. One application of iris recognition system developed for a voting process is presented in this chapter along with one hardware implementation of the same. This chapter also demonstrates the various results obtained for all the test images along with the necessary observations and explanations in the form of discussions. Contributions no. 7, 8 and 9 falls under this chapter.

Overall conclusions of research work

To conclude, an iris recognition scheme using the concepts of Pre-processing (P), Segmentation (S) and Normalization (N) mentioned in the earlier section is being developed. To test its validity and effectiveness of working of the proposed methodologies, a test image is being selected for detection purpose by giving as input to our proposed algorithm and is found to be detected in one case (1) and not detected in the other case (2). Like this, any number of test patterns can be given as input to the developed algorithm and its presence in the stored database can be found out. One excellent advantage of these 6 methodologies developed are that the computation time required for processing and giving the output is just within 10 seconds, which shows the advantage of our proposed method over the others.

In a nutshell, the purpose of carrying out the research work was to overcome the limitations of the works done by the various researchers on the biometric authentication using iris concept till date and to develop a fast biometric authentication system. The objectives that was set for the proposed research work have been met completely and the selected drawbacks had been overcomed by the way of comparison with the others. In this context, a highly effective iris biometric system/methodology has been developed incorporating a huge number of salient features. To conclude, a sincere attempt is being made to develop simple and efficient methods for

iris recognition in "unconstrained environments" using a combination of several methodologies (hybrid algos) in the various process of the iris biometric recognition which could be seen from the results in the research paper.

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