International Journal of Engineering Applied Sciences and Technology, 2022
Vol. 7, Issue 5, ISSN No. 2455-2143, Pages 92-94
Published Online September 2022 in IJEAST (http://www.ijeast.com)

CAMERA BASED FINGERPRINT AUTHENTICATION SYSTEM USING MATLAB

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Abstract— **"At the end of the day, the goals are simple: safety and security" -Jodi Rell**

The above quote shows the importance of security in the whole society. We can see how safety and security is playing an important role in our day-to-day life. Despite the multitude of personal identification methods currently in practice, fingerprint verification has traditionally been considered one of the most reliable methods available.

But is it the safest means during the time of COVID-19 pandemic? Our traditional scanner-based fingerprint authentication system requires the major upgrade to sustain in the current scenario. Can whole process be contactless…….

Keywords- **RESNET-50, Sobel Filter, SURF Method, DOF.**

I. INTRODUCTION

Due to the Pandemic, we realized that the physical scanner-based fingerprint verification systems could not be used due to the fear of contamination but they were in widely use before this. From office attendance to secure entrance these were dominating the section. And different research has proven [1-2] that fingerprint-based security is one of the most reliable ways and moreover we have found that in office attendance and other purpose the finger print data which were acquired during the setup process are also going in waste So, here we come up with a fingerprint verification system that uses a camera instead of a physical scanner to capture the fingerprint and give the output. This eliminates the contamination fear and we have added the different layers of security in it by neural network with the help of RESNET-50, Multilayer filtrations process so on all of this has been describe in this paper.

II. PROPOSED ALGORITHM

The whole model is divided into two stages fingerprint acquisition and other is image verification. These were further divided into 2 sub categories like in acquisition we have image capturing and image recognition and in verification we have processing and matching.

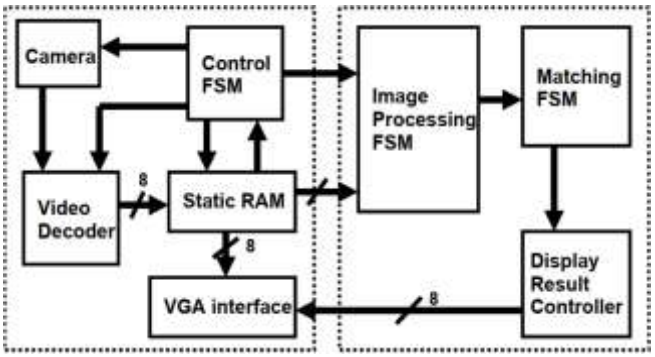

Fig. 1. Basic block of the system

A. Image acquisition model –

We have used a fixed focus camera to capture the image as there are lots of disadvantage of using it over autofocus camera but the advantage it provided over it rule out all of those. So, while using the auto focus camera we were not concern on the distance of the subject as camera would automatically adjust it focus but this introduces a lot of noise for subject with deep depth of field (DOF) Moreover, if we keep on changing the distance it would create some distortion while conversion of 3D to 2D image which at the end might affect the accuracy of the whole system [3-4]. So, we decided to use a fixed focus camera with an ultrasonic sensor placed in front of it. This ultrasonic triggered the whole system and also keeps the distance from the camera always under consideration while acquiring the image.

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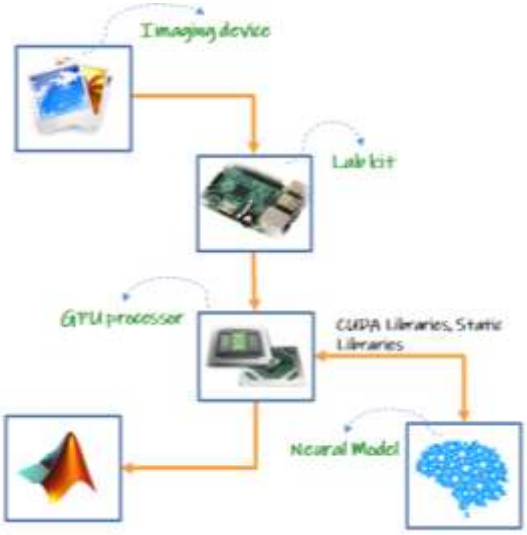

Fig. 2. Structural outline of image acquisition model

Coming to the second part of this model since it's a image-based system authentication we have use the neural network to recognize the image whether it the quality of image is fine for further processing and it also add a layer of security by checking if someone is try to fool the system with different means like by showing the image from phone or something like that. And to achieve this in MATLAB we have used the RESNET-50 model.

B. Image Verification Model –

Once the image is acquired in RAM, we start processing with a basic step of grayscale conversion. This conversion is of very high importance as most of the filters used in MATLAB use a weightage method for the calculations, the different colors have different weightage assigned to them, which may cause unexpected errors in the final edge map and hence, resulting into wrong or no output.

Now, this grayscale image is been used in the next step, i.e., the filtration process. Now MATLAB supports mainly 2 categories of filter.

1. Gaussian based filter
2. Gradient based filter

Under these categories we have different filter like Sobel filter, Prewitt filter, Robert's filter, Canny filter and LOG filter. Now to finalize the type of filter we have used the below table.

FILTER / PROPERTIES	SOBEL FILTER	PREWITT FILTER	ROBERTS FILTER	CANNY FILTER	L.O.G FILTER
INTRO	➢ Gradient is maximum ➢ Sobel Approx. Of derivative	➢ Gradient is maximum ➢ Prewitt Approx. Of derivative	➢ Gradient is maximum ➢ Roberts Approx. Of derivative	➢ Uses local maxima of gradient ➢ Derivative of gaussian filter	➢ Uses Zero-Crossing for the filtration process
DIRECTIONAL FILTERATION	AVAILABLE ON BOTH AXES	AVAILABLE ON BOTH AXES	➢ 45° from horizontal, ➢ 135° from horizontal	NOT AVAILABLE	NOT AVAILABLE
EDGE THINNING	AVAILABLE	AVAILABLE	AVAILABLE	NOT AVAILABLE	NOT AVAILABLE
STANDARD DEVIATION	NOT AVAILABLE	NOT AVAILABLE	NOT AVAILABLE	AVAILABLE	AVAILABLE
DIRECTIONAL GRADIENT	AVAILABLE	AVAILABLE	AVAILABLE	NOT AVAILABLE	NOT AVAILABLE

Table.1. Comparision between the filters.

So, from the table itself it's very clear that Sobel and Prewitt have directional filter and we are in need of direction filter too as it would add a layer of security in our system.

Now to choose one from them we have gone through different experiment [4-6] and found that Sobel is best suited for us as it would produce the desire result without adding much of the threshold values.

III. WORKING

In image acquisition system the basic flow is video decoder file is captured, a frame is hold by freeze mode in ZBT then the image is stored in RAM after clock synchronization and then different recognition models are run to select the desired result and the image is passed to stage 2 for further processing.

So in stage 1 firstly, the image device which is a fixed focus camera would capture a video decoder file which would triggered by an ultrasonic sensor then, we have a Raspberry Pi model which will perform the task of extracting a particular frame from the video decoder file and synchronising the clock cycle and store the pre-processed image for further processing then there is a GPU processor which will accelerate the process of image classification and detection which will interact with the convolution neural model this convolution neural model is a RESNET-50 where we have not used this convolution neural model for the original classification task we have repurposed it to solve a different classification tasks in our system finally we have to synchronise all the result to a mat file to produce a desirable result and can store it for further different type of filtration process.

Now coming to the stage 2 once we have an image stored in the RAM, we convert that image into a grayscale image and then we use the particular grayscale image for filtration process where we have used the Sobel filter for it. First, we run the original image directly to the Sobel filter then for more detail and confirm output of the fingerprint verification directional filters are also being used we have done in both horizontal and vertical axis. So now we have 3 images to compare with our database for matching with correct match. For matching purpose, we have used a feature extraction method. we have extracted the required features from a

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filtered image using the surf method and then we have matched the particular features for the outcome.

IV. EXPERIMENT AND RESULTS

We have built a complete working prototype of the system which is been shown in figure 3.

Fig. 3. Working model of the system

We have done 13 types of different experiment receptively under different condition several time which have approximated to 60+ experiment. These 13 types of experiment involve changing the ambiance light, showing a pic from phone, effect of movement, effect of background and many such kind. And Our model has successfully pass 7 of such experiment Hence, we conclude that the accuracy of whole system is about 54%, but keeping in mind the practical grounds the efficiency of system is (54 +/- 5) %.

Which is an acceptable efficiency for a prototype have low end GPU, higher efficiency can be achieve through better external GPU's and hardware.

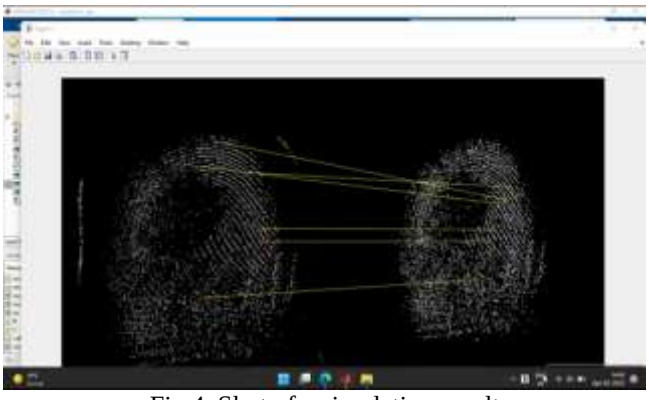

Fig.4. Shot of a simulation result

V. CONCLUSION

This report detailed the image acquisition and image verification processes for a fingerprint verification system. While the system was completely implemented all though it's a prototype model and the result achieve through it is more than satisfactory.

The future scope of the project can be to increase the efficiency by putting more filter and advance A.I. program and finally completely replacing the scanner type fingerprint authentication system.

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