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FINGER-VEIN RECOGNITION SYSTEM FOR E-VOTING

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Abstract : The system is implemented on an embedded platform and equipped with a novel finger-vein recognition algorithm. The proposed system consists of three hardware modules: image acquisition module, embedded main board, and human machine communication module. The structure diagram of the system is, that the image acquisition module is used to collect finger-vein images. The Embedded main board including the Microcontroller chip, memory (flash), and communication port is used to execute the finger-vein recognition algorithm and communicate with the peripheral device. The human machine communication module (LED or keyboard) is used to display recognition results and receive inputs from users. Our proposed system is an intelligent security system. Here we developed voting machine concept. If finger vein matched, means we can vote, counting information passing via GSM technology.

IndexTerms **- Biometric, Deep Learning, Embedded, E-Voting, Feature Extraction, Finger Vein.**

I. INTRODUCTION

Finger vein recognition is a novel biometric authentication technique. It compares the vascular pattern of a person's finger to previously collected information. The field of finger vein biometrics is currently in the focus. Because it is so young in comparison to other biometric domains, the information available, aside from the research that have been completed, is limited. The benefits of employing finger veins as biometrics are obvious and serve as the primary motivator for implementing this technology. To begin with, it is a difficult-to-forge biometric feature, as its primary function is to emit infrared light in the finger and capture the structure of the veins with a camera.

The form of the vein in the finger is well-known that they remain constant over time and may be measured without causing pain to the person. The finger vein trait meets at least some of the seven criteria [1] that determine a biometric trait's fitness for identity authentication: (1) universality, (2) uniqueness, (3) permanence, (4) measurability, (5) performance, (6) acceptability, and (7) circumvention. As a result of these benefits, finger vein biometrics has gained traction, piquing the interest of most scholars to do study in this area.

II. EXISTING SYSTEM

Passwords or Personal Identification Numbers (PINs) are commonly used to offer private information, and while they are simple to use, they are vulnerable to being divulged and forgotten. Biometrics, which utilizes human physiological or behavioral features for personal identification, is gaining popularity and is quickly becoming one of the most popular and promising alternatives to password or PIN-based authentication approaches.

Biometric patterns for the face, iris, fingerprint, palm print, hand shape, voice, signature, and gait are among the numerous accessible, and many such systems have been created and implemented. Despite the wide range of biometric patterns available, no biometric has yet been established that is completely dependable or safe.

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For example, fingerprints and palm prints are easily forged; voice, signatures, hand shapes, and iris images are easily forged; face recognition can be hampered by occlusions or face-lifts; and biometrics, such as fingerprints and iris and face recognition, are vulnerable to spoofing attacks, in which biometric identifiers can be copied and used to create artefacts that can fool many currently available biometric devices.

III. PROPOSED SYSTEM

The finger-vein is a promising biometric pattern for personal identification in terms of its security and the vein is concealed inside the body and usually imperceptible to human eyes, forging or stealing it is difficult. Finger-vein capture that is non-invasive and contactless is more convenient and hygienic for the user, and hence more acceptable. Only a live body can be used to extract the finger-vein pattern. As a result, it's a natural and persuasive confirmation that the person whose finger-vein has been successfully collected is still alive.

IV. WORKING OPERATION

4.1 Preprocessing

Preprocessing is preparing the data for further analysis. It has the following techniques resizing, color conversion and filtering. Preprocessing technique is used to remove unwanted data and filter our input image. It will compress our input image this method will make further execution quickly.

4.1.1 Spatial Filter

A digital image can be thought of as a two-dimensional function f (x, y), with the x-y plane indicating spatial position information, which is referred to as the spatial domain. Spatial domain filtering refers to the filtering operation based on the x-y space neighborhood. The filtering procedure is to move the filter in the image function f (x, y) point by point until the center of the filter coincides with the point (x, y). The response of the filter is calculated at each point (x, y) based on the filter's specific content. Fig.1 shows the preprocessed image using spatial filter.

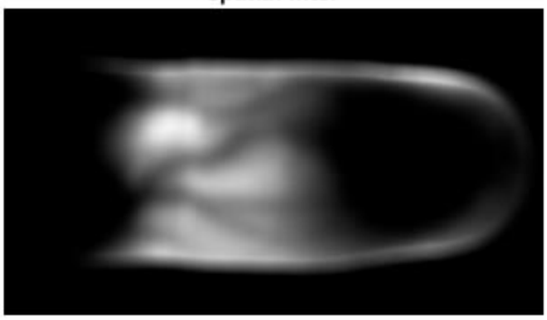

Figure 4.1 Finger Vein Preprocessing Using Spatial Filter

4.1.2 Average Filter

Average (or mean) filtering is a technique for smoothing images by reducing the amount of intensity variation between adjacent pixels. The average filter works by looping through the image pixel by pixel, replacing each value with the average value of the pixels around it, including itself. Fig.2 shows the preprocessed image using average filter.

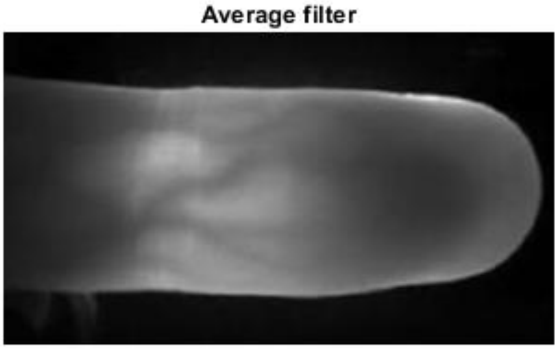

Figure 4.2 Finger Vein Preprocessing Using Average Filter

4.2 Feature Extraction

Next feature extraction, in which the texture features are extracted using Discrete Wavelet transform.

4.2.1 DWT Based Feature Extraction

DWT decomposes the preprocessed image on multiple levels, resulting in the efficient extraction of discriminant features that are insensitive to arbitrarily defined environmental variations. DWT is a wavelet transform in which the wavelets are sampled at discrete intervals. DWT provides image information in both the spatial and frequency domains. An image can be analyzed using DWT by combining an analysis filter bank and a decimation operation. The analysis filter bank consists of a pair of low and high pass filters for each decomposition level. The low pass filter extracts the image's approximate information, whereas the high pass filter extracts the image's details, such as edges. The 2D transform is created by combining two separate 1D transforms. Approximation coefficients in 1D DWT contain low frequency information, whereas detail coefficients contain high frequency information. The application of 2D DWT decomposes the input image into four distinct sub bands: low frequency components in horizontal and vertical directions (cA), low frequency components in horizontal and vertical directions (cV), high frequency components in horizontal and vertical directions (cH), and high frequency components in horizontal and vertical directions (cH) (cD). cA, cV, cH, and cD can also be written as LL, LH, HL, and HH.

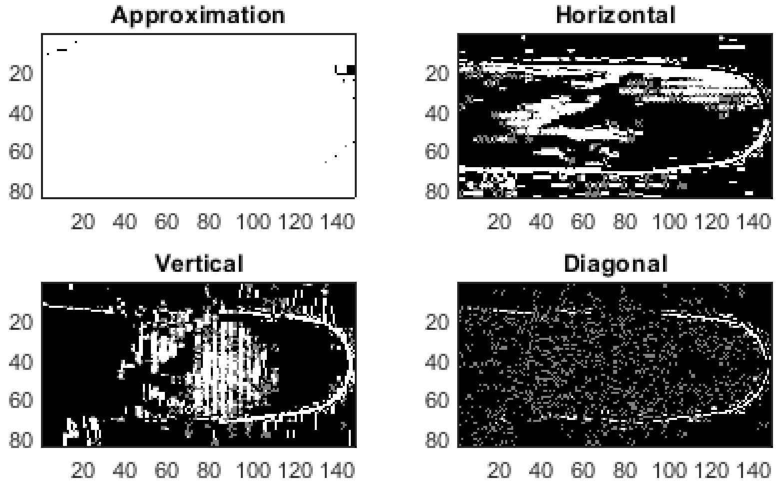

Figure 4.2 Finger Vein Feature Extraction Using DWT

4.2.2 GLCM Based Feature Extraction

The texture features are extracted using Gray Level Co-occurrence Matrix (GLCM). Texture features calculated using GLCM are Contrast, Correlation, Entropy, Energy. A Co-occurrence matrix by calculating how often a pixel with the intensity (gray-level) value i occurs in a specific spatial relationship to a pixel with the value j. So, this co-matrix method will extract the texture features from our input image.

4.2.2.1 Energy

It is a measure the homogeneousness of the image and can be calculated from the normalized COM. It is a suitable measure for detection of disorder in texture image.

4.2.2.2 Entropy

Entropy gives a measure of complexity of the image. Complex textures tend to have higher entropy Where, p (i, j) is the co-occurrence matrix.

4.2.2.3 Contrast

Measures the local variations and texture of shadow depth in the gray level co-occurrence matrix.

4.2.2.4 Correlation

Measures the joint probability occurrence of the specified pixel pairs.

4.2.2.5 Homogeneity

Measures the closeness of the distribution of elements in the GLCM to the GLCM diagonal.

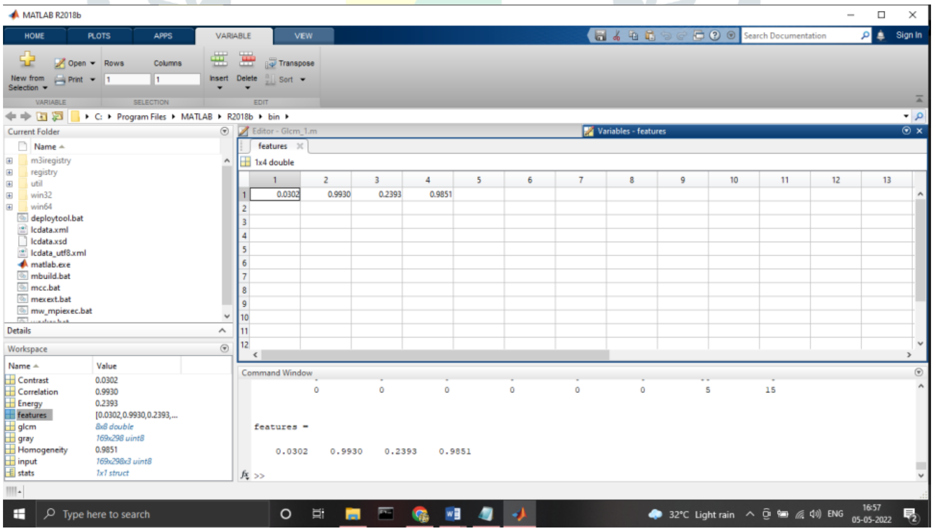

Figure 4.3 Feature Extraction Using GLCM

4.4 Convolution Neural Network

We start with an image and process it through a sequence of convolutional, nonlinear, pooling (down-sampling), and fully connected layers to produce an output. That output could be a single class or a set of classes that best describe the image. The network assigns a certain class to each input vector because that class has the highest likelihood of being correct. The Input Layer, Radial Basis Layer, and Competitive Layer are the three layers of the CNN. The vector distances between the input vector and the row weight vectors in the weight matrix are calculated by the Radial Basis Layer. Radial Basis Function scales these distances nonlinearly. Competitive Layer finds the training pattern that is closest to the input pattern by calculating the smallest distance between them.

4.5 Hardware

The hardware consists of three modules Serial communication, GSM module, Input module and output module. The input image database of finger vein is fed into the PC through the serial communication. And it is connected to Universal Asynchronous Receiver Transmitter (UART). The GSM module acts as the communication which uses a 2G network for communication. The GSM module send the information through SMS. The input module consists of two polling switch that acts as the button for two parties. The input switches are given in D3 and D4 in the node MCU. The output module consists of LCD display, green LED and red LED. The image after feature extraction and convolution is compared with the finger vein image in the database once the switch is pressed. If the person is an authorized voter the green LED will be switched ON. If the person is an unauthorized voter, then red LED will be switched ON and notification will be send to the person through SMS.

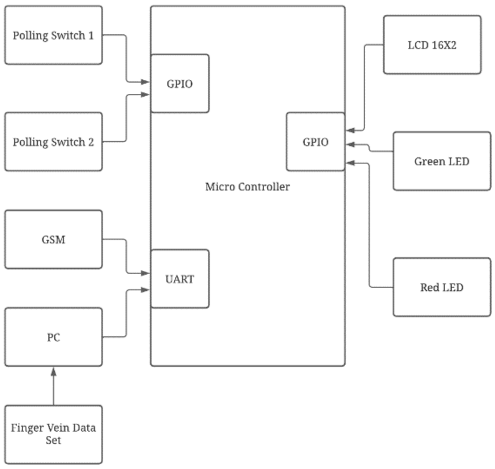

Figure 4.4 Finger Vein Hardware Block Diagram

V. RESULTS AND DISCUSSION

4.1 Results of Descriptive Statics of Study Variables

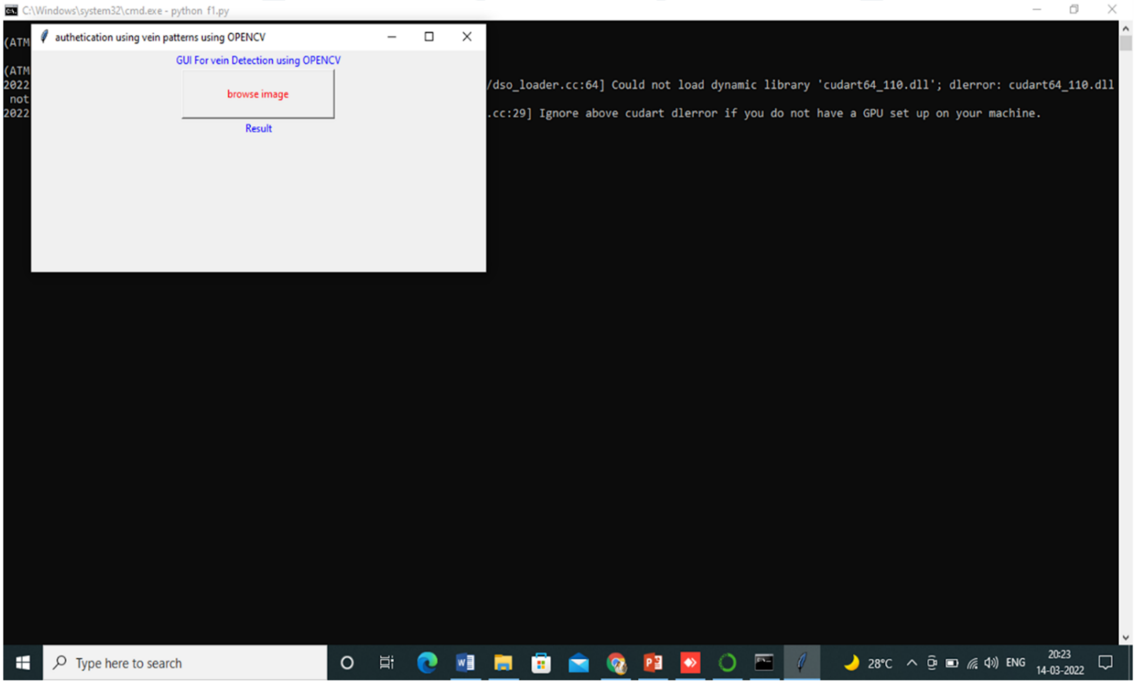

Figure 4.5 Authentication Using Finger Vein

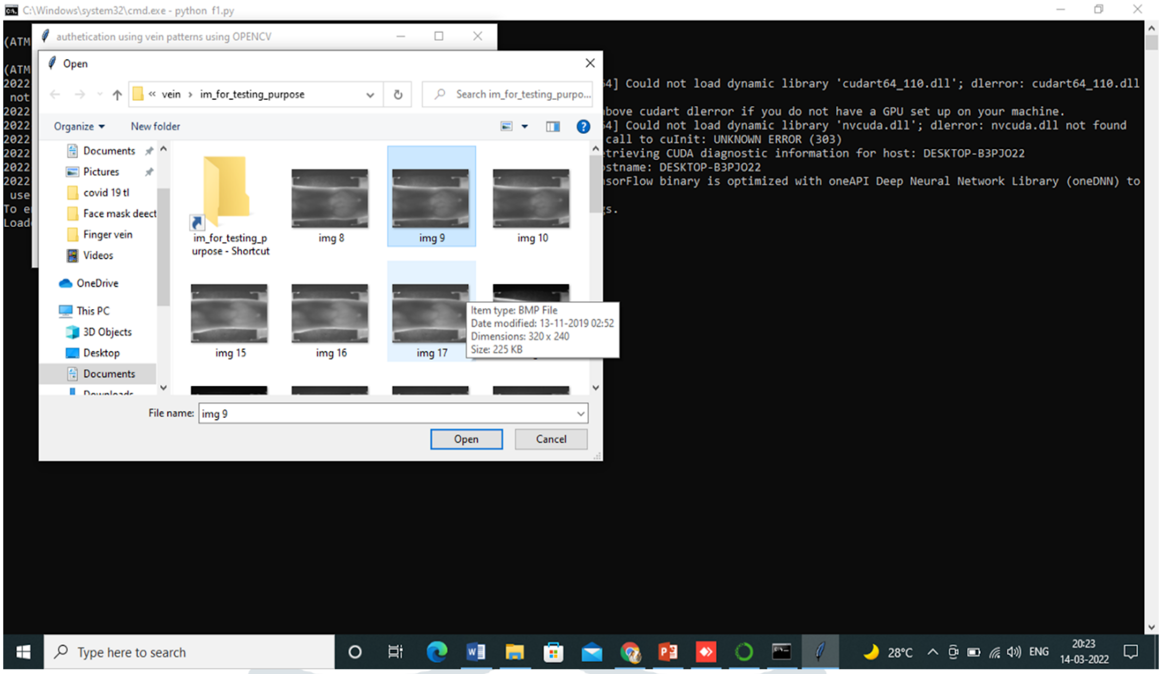

Figure 4.6 Uploading Finger Vein

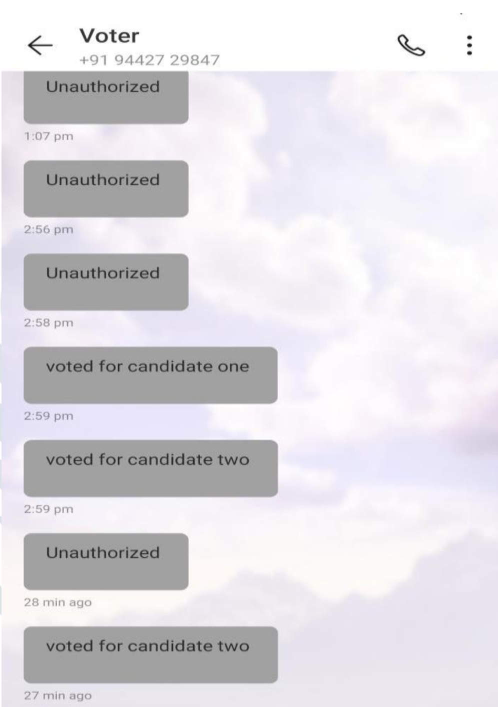

Figure 4.7 Message Received through GSM

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