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VEIN BIOMETRIC AUTHENTICATION USING ANDROID APPLICATION

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Abstract: Human recognition on smartphone devices for unlocking, online payment, and bank account verification is one of the significant uses of biometrics. The exponential development and integration of this technology have been established since the introduction in 2013 of the fingerprints mounted sensor in the Apple iPhone 5s by Apple Inc. (Motorola ATRIX was previously launched in 2011). Nowadays, in the commercial world, the main biometric variants integrated into mobile devices are fingerprint, facial, iris, and voice. In 2019, LG Electronics announced the mobile exhibiting vascular biometric recognition, integrated using the palm vein modality: LG G8 Thin Q (hand ID). In this work, in an attempt to become the become the first research-embedded approach to smartphone vein identification, a novel wrist vascular biometric recognition is designed, implemented, and tested on the Xiaomi POCO phone F1 and the Xiaomi Mi 8 devices. The near- infrared camera mounted for facial recognition on these devices accounts for the hardware employed. Two software algorithms, TGS-CVBR R and PIS- CVBR R, are designed and applied to a database generation and the identification task, respectively. The database, named UC3M-Contactless Version 2 (UC3M-CV2), consists of 2400 contactless infrared images from both wrists of 50 different subjects (25 females and 25 males, 100 individual wrists in total), collected in two separate sessions with different environmental light environmental light conditions. The vein biometric recognition, using PIS-CVBR, is based on the SIFT, SURF, and ORB algorithms.

Index Terms–Motorola ATRIX, Xiaomi, TGS-CVBR, PIS-CVBR, SIFT, SURF, ORB.

1.INTRODUCTION

In recent years, biometric recognition has been a significant field in the security world that has witnessed an exponential increase in the integration of authentication systems in daily life: access control, online payments, bank account access, and device unlocking. Security and, of course, comfort are the two leading causes. Hygiene is another important concern behind this constant and impressive growth of biometric-based systems, especially multiuser systems (e.g., access control). For this purpose, noncontact systems are designed. There are numerous contactless biometric modalities: facial, voice, iris, gait, vascular, and contactless fingerprint. In this study, a non-contact wrist vein biometric system integrated into a smartphone device is presented. For this purpose, two devices, designed by Xiaomi Inc. are used as complete capture, processing, and storage and storage hardware: Xiaomi POCO phone F1 and Xiaomi Mi 8. Both mobiles mount a near infrared camera originally used to unlock them with facial recognition. Two software algorithms have been proposed and registered: Three-Guideline Software for Contactless Vascular Biometric Recognition (TGS-CVBR R) and Preprocessing and Identification Software for Contactless Vascular Biometric Recognition (PIS-CVBR R). Both have been implemented using Android TM. The former, TGS-CVBR R, has been used to generate a contactless database and it also provides feedback to the user on how to place the wrist correctly during the recognition process. Then, PIS-CVBR R is in charge of the biometric recognition task. The recognition software algorithms have been classified into three groups or steps: preprocessing, feature extraction, and feature comparison. PIS-CVBR algorithm consist of SIFT, SURF and ORB algorithms used for feature extraction and comparison.

2 .LITERATURE REVIEW

2.1 A Low-Cost Wrist Vein Ensor for Biometric Authentication, 2016

R. Raghavendra and C. Busch investigate the biometric identification of an individual can be done using physical traits like a face, palm print, vein, etc., as well as behavioral traits like locomotion, keystroke, mouse dynamics, etc. Wrist vein recognition has a reputation for excellent accuracy, stability, and spoof-resistance among the several biometric modalities. The quality of the wrist vein picture that is collected by the sensor has a high correlation with the success of wrist vein biometrics. In this study, a novel wrist vein sensor is used to, near-infrared (NIR) illumination to provide an excellent wrist vein picture[1]. The NIR lighting used in this project has a 940nm light emission capability, which is used to illuminate the hand's wrist region.

2.2 Near- Infrared Illumination Add-On for Mobile Hand-Vein Acquisition, 2018

L. Debiasi, C. Kauba, B. Prommegger, And A. Uhl presented that every person's network of blood vessels under their hand's skin and in their fingers creates a different structure. Consequently, blood vessel traits are appropriate for biometric applications. Images of the blood vessels can be used for authentication, much like fingerprints. LED Ring with 16 NIR LEDs (850 nm) that may each be operated separately. NIR pass-through filter having a cut-off wavelength of 780 nm. A smartphone software that has been developed allows for brightness control and picture and video capture.

2.3 AI– Based Mobile Bill Payment System Using Biometric Fingerprint,

Ayyaswamy Kathirvel, D. Sudha, S. Naveneethan, &M. Subramaniam introduces a biometric payment application that develop the concept of material less payment. It enables users to make payment at any location by enrolling their fingerprint without possessing any material. It consists of two activities – user registration and biometric payment. It involves a onetime registration for user details upon all further transaction are validate and processed based on user's fingerprint where the App take care of the whole process [2]. In biometric section, user fingerprint is collected using scanner and encode into byte array for further comparison .Using a minutiae extraction algorithm, confirm the produced fingerprint matches the previous saved fingerprint or not. This implementation results in a novel payment method and avoid the risk of carrying valuable materials outdoor.

3. RESEARCH METHODOLOGY

3.1 Architecture

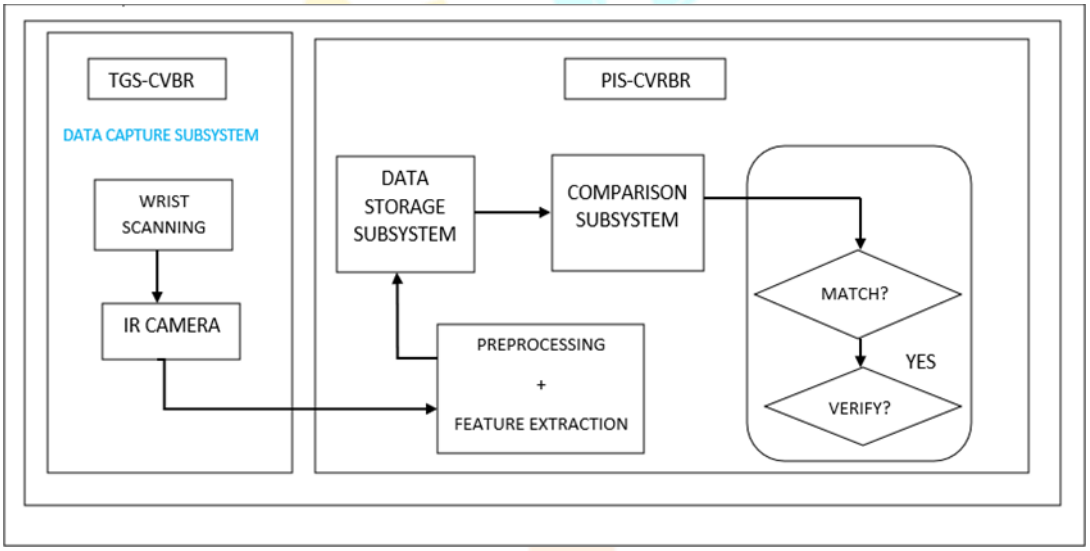

Fig 3.1: Basic Architecture

The architecture consists of two software algorithms are TGS-CVBR and PIS-CVBR. The architecture consists of two software algorithms are TGS-CVBR and PIS-CVBR as shown in the above figure. TGS-CVBR displays the real-time video of the near-infrared camera capture (640 * 480 resolution) on the smartphone screen and three guidelines. PIS-CVBR consists of SIFT, SURF and ORB.SIFT and SURF is used to extract the feature and find key points. ORB is used for future comparison based on BRUTE FORCE distances .Firstly a user can register the wrist image by using an infrared camera. Then the two software perform image compression, processing and feature extraction and find the key point and store the extracted image. Compare the previously registered image with the new image if there is any match, it permits else it gives an error message.

3.2Implementation

3.2.1 Image Preprocessing:

Preprocessing the image to eliminate the noisy features use clahe algorithm and histogram equalization method .Clahe algorithm has three parts: title generation, histogram equalization and bilinear interpolation .The input image is first divided into sections and each section called tile. Then perform histogram equalization based on predefined clip limit.

3.2.2Feature Extraction

i. Extraction of unique features from pre-processed wrist vein images using
   a)SIFT (Scale-Invariant Feature Transform) Algorithm
   b)SURF (Speeded Up Robust Features) Algorithm
   c)ORB (Oriented FAST and Rotated BRIEF) Algorithm
ii. Collect Extracted features and eliminate the features based on a predefined threshold value.

3.2.3 Feature Comparison

Compare the keyfeatures based on the distances between keypoint. Check that the number of keypoint in the images are matched ,if the number is less than threshold then authentication failed .It is based on calculating the brute force matches between the keypoints.

3.3.4Testing

Capture vein image through webcam and store the vein image in database. User Registration with basic details and retrieve vein images from database .Login with username and vein image from database then perform image pre-processing (as step 1) feature

extraction from image (as step 2) conduct Feature comparison (as step 3) recognition result based on the feature comparison and show result.

3.3 System Requirements of the System

Hardware Part:

- •Near infrared LEDs are used for making LED array for providing illumination for capturing veins.
- •USB Night vision camera is used for capturing the images and it is connected to the PC

Embedded Devices:

- •Near Infrared LED: 750-900nm wavelength
- •USB Night Vision camera

Hardware Specification:

- •Processor: i3 or i5 (i5 is better)
- •RAM: 8GB (Minimum)
- •Hard Disk: 500GB or above
- •Mouse
- •Keyboard

Software Specification:

- •Tool: Python IDLE, Anaconda, Visual Studio Code, Android Studio
- •Python: version3
- •Operating System: Windows 10
- •Front End: Android XML
- •Back End: Python
- •Database: SQLite

3.4 Algorithm

3.4.1 SIFT

SIFT (Scale-Invariant Feature Transform) works by identifying key-points based on their local intensity extrema and computing descriptors. That capture the local image information around key-points. The process divided into 4 steps,
Constructing a Scale Space: to make sure that features are scale-independent. Keypoint Localization: identifying the suitable features or keypoints .Orientation Assignment: ensure the keypoints are rotation invariant. Keypoint Descriptor: assign a unique fingerprint to each keypoints. Finally, we can use these keypoints for feature matching.

3.4.2 SURF

SURF (Speed Up Robust Features) is a computer vision algorithm used for feature extraction and matching in image processing tasks. The main purpose of the SURF method is to detect and describe robust and distinctive features in images, which can be used for tasks such as object recognition, image registration, and image stitching. The key features of the SURF method:

1. Speed and Efficiency
2. Scale and Rotation Invariance
3. Robustness to Affine Transformations
4. Efficient matching
5. Descriptor Generation
6. Matching and Recognition

3.4.3 ORB

Oriented FAST and Rotated BRIEF (ORB) performs as well as SIFT on the task of feature detection (and is better than SURF) while being almost two orders of magnitude faster. ORB builds on the well-known FAST keypoint detector and the BRIEF descriptor. Both of these techniques are attractive because of their good performance and low cost. ORB's main contributions are
The addition of a fast and accurate orientation component to FAST ,the efficient computation of oriented BRIEF features ,analysis of variance and correlation of oriented BRIEF features .A learning method for de correlating BRIEF features under rotational invariance, leading to better performance in nearest-neighbor applications.

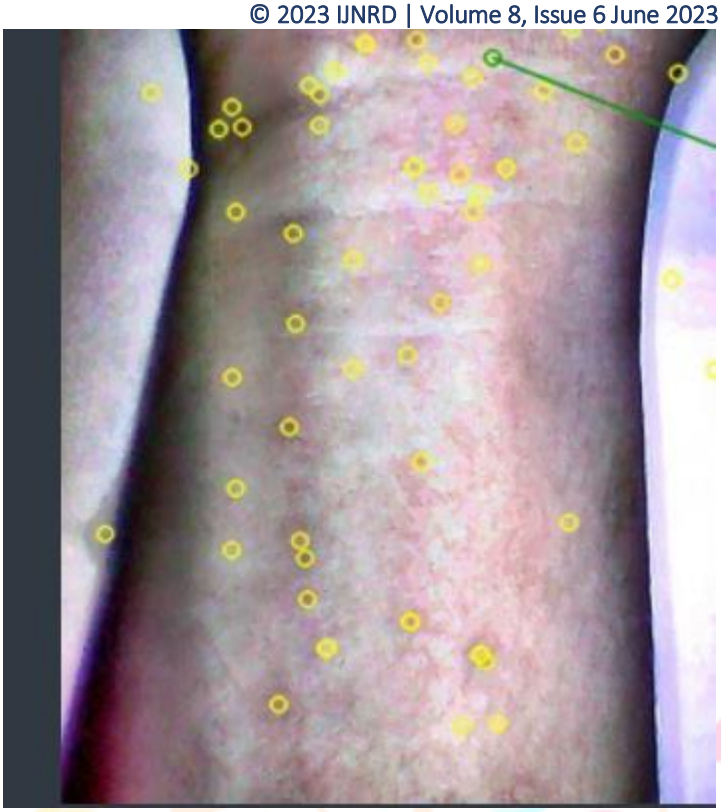

Fig 3.4.1 : keypoints

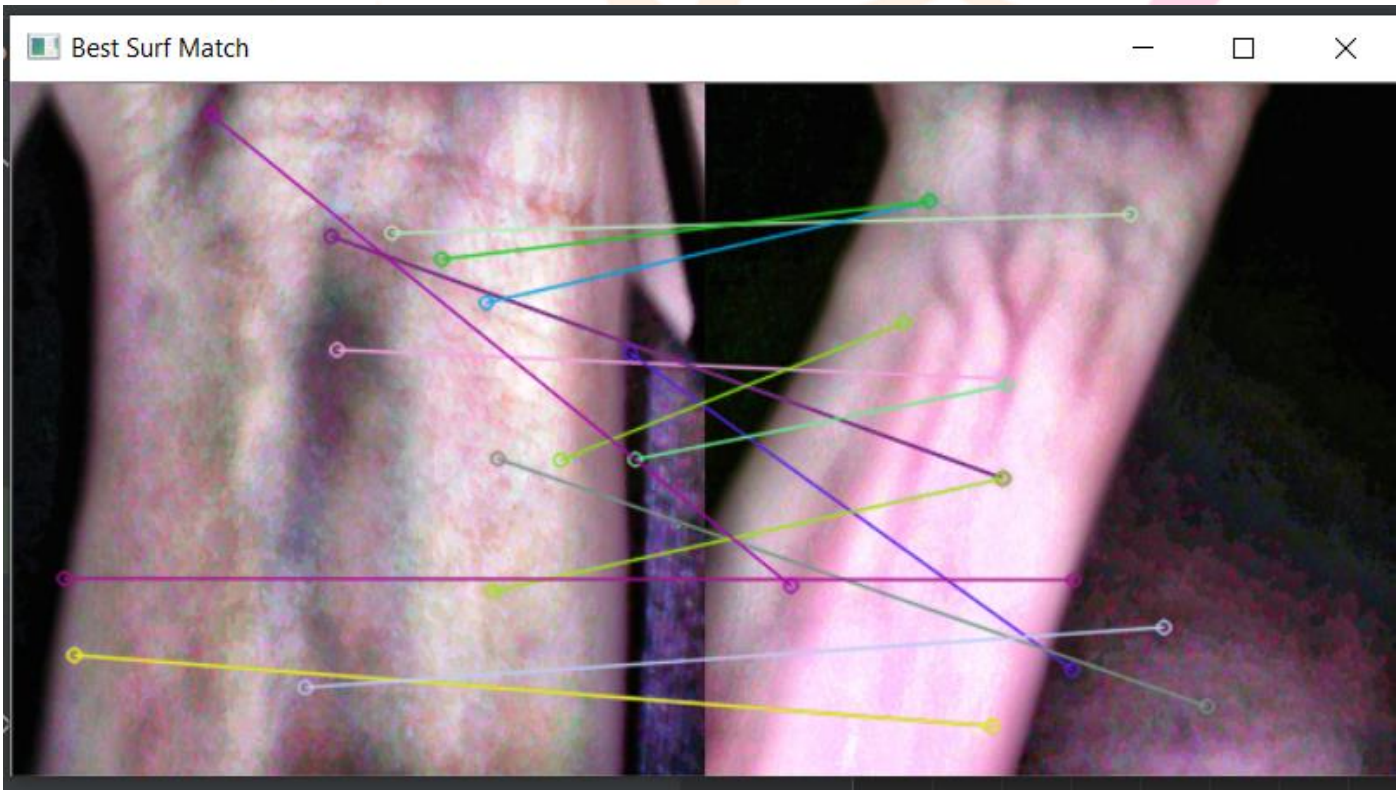

Fig 3.4.2: feature matching

3.5 Module

Hardware module consist of IR array contain IR led , battery and transistor shown in fig 3.5.1

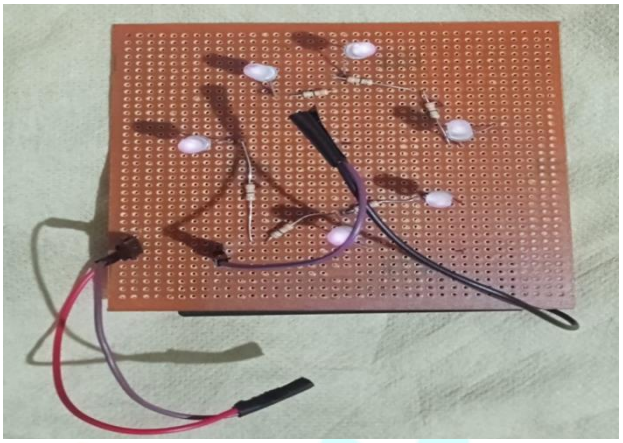

Fig 3.5.1: IR Array

Webcam is used to capture vein image in a scattered manner , it is shown in the fig 3.5.2

Fig 3.5.2: webcam

Registration Page and login

User can register by providing user name and basic details and click capture image option for capture image shown in figure 3.5.3.This image and basic details and mapped and stored in database .A registered user can login shown in figure 3.5.4 by enter username then capture image. The system compare the user name and image of previous database content if two image and user name satisfy a threshold then system permit the user otherwise system give an error message.

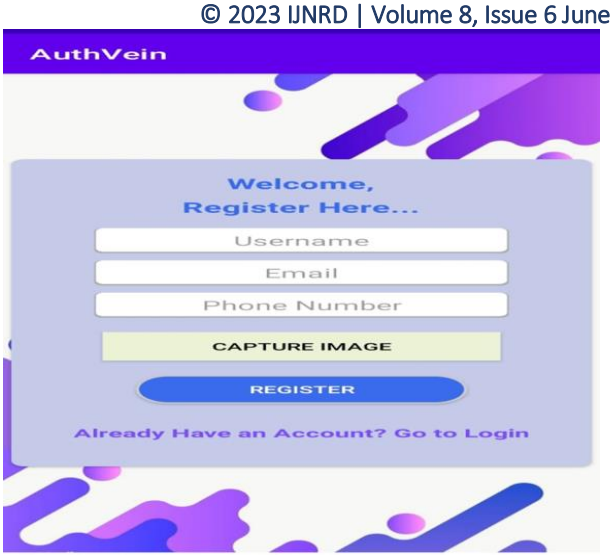

Fig 3.5.3 :User registration

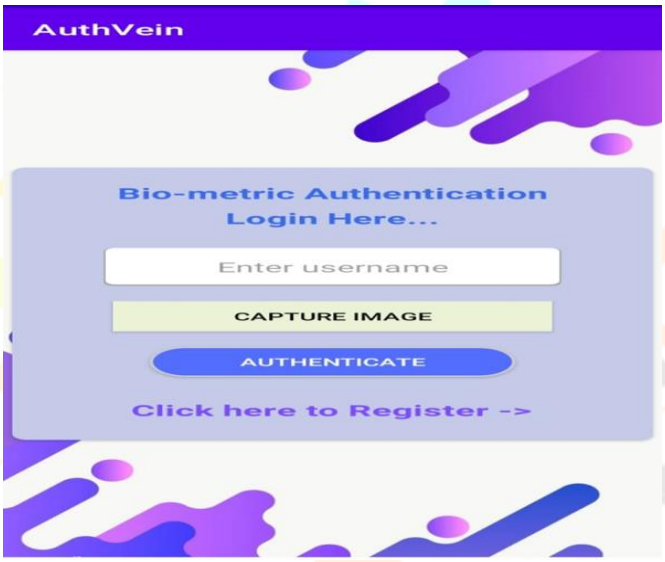

Fig 3.5.4: User login

4. RESULT ANALYSIS

To obtain the computation power and performances of system we inputed the different type of biometric image, to check that the system can able to detect the vein in a fatty as well as skeleton condition. To check the accuracy of system we perform the algorithm on a large dataset also we consider the changes occurs in wrist in all case our system correctly detect the user. We check the hardware accuracy by considering the light condition from dim light to bright light that is IR array emit all other light radiations and it only focused on the portion contain high intensity of blood cells.

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