Identification and Verification of Person Using Hand Based Biometric Features

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Abstract: In recent years for recognition of person no. of methods are available, out of which Biometric system becomes most reliable one .Unimodal biometric system is one type of biometric system which is widely used in different industry and organizations for authentication of purpose. Even though unimodal biometric system widely accepted for recognition purpose, it has its own limitations. Because of this it is mostly used in those organizations where middle level of security is essential. To overcome limitations of biometric system which is used single biometric traits for identification purpose, there is need of such better performed system. This can be achieved by combining results of multiple unimodal system .So, because of this combining effect, multimodal system has all characteristics of that unimodal systems from which it is build. By considering this advantage of multimodal system over unimodal system objective of proposed system is to build multimodal biometric system which has characteristics as high level accuracy, reliable results of person recognition and robust in nature. It uses finger knuckles, palm print and finger geometry as inputs (biometric traits) for authentication of person. Image of hand acquired through Image acquisition system is used in preprocessing stage to get ROI of fingers and palm. In extraction stage finger geometry and finger knuckles of ring, middle and index fingers are extracted. And also key points which represent palm print features are also extracted to get ROI of palm. KNN classifier is used for classification of purpose. To boost speed of matching process a hierarchical method is used. To get high accuracy of features AND rule fusion is used. With help of thermal and PIR sensors aliveness of person is detected to avoid spoofing in biometric system.

Keywords: Biometric system, unimodal, multimodal, palm print, finger geometry finger knuckles, KNN classifier, AND rule, ROI, Aliveness detection, PIR sensor, Thermal sensor.

I. INTRODUCTION

In recent years security becomes important factor in industry and organizations. Biometric identification becomes popular among many identification methods. Identification and verification of person by using biometric system is widely accepted by peoples. In biometric system as input biometric traits such as person's features like thumb impression, palm print, iris, voice etc are used. According to system's requirement, person's biometric traits are used which may be physiological or behavioral. Each person has unique characteristics, so these characteristics can be efficiently used by biometric system as input for person authentication purpose. As result we get highly secured identification system which eliminates all drawbacks caused due to traditional person identification system. Today numbers of biometric traits are used. Each has its own contribution in system in the form of performance, convenience, reliability. Examples of such biometric traits are finger print, palm print, iris, voice, digital signature, thumb stroke etc. Typical block diagram of biometric system is shown in following figure1
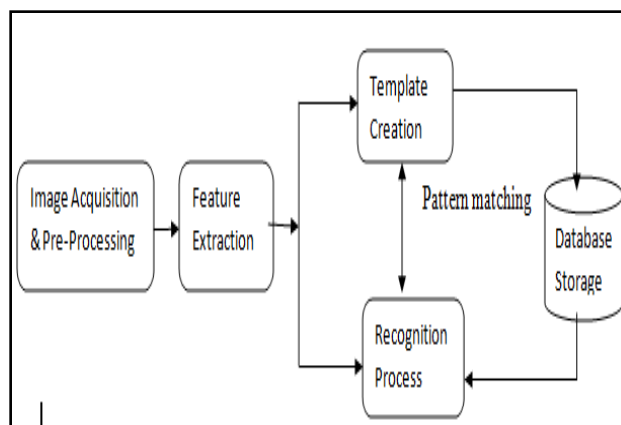

Figure 1: Biometric Recognition System

Acquisition Unit:
In this unit input is taken for system which is in the form of image. So no doubt quality of image must be important for further processing.

Preprocessing Unit:
With the help of various techniques acquired image is preprocessed for next steps. In image preprocessing removal of unwanted frequencies, noise is takes place. Normalization of image is carried out.

Feature extraction Unit:
By using various extraction algorithms features are extracted. These extracted features are represented in the form of vector form which further used in matching process.

Template Generator:
After feature extraction phase, template generator creates templates from extracted features and stored it.

Matching Unit:
Feature extracted in previous step are compared with templates. Process of identification becomes successful if images are matched.
These are general phases of biometric system for identification purpose.

II. LITERATURE REVIEW

Ease of use becomes prominent characteristic of hand-based biometrics and which becomes main reason its wide acceptance by people. No. of researchers shows that personal identification can becomes more reliable when you used unique characteristics of multiple features of biometric traits in single biometric system that is by building a multimodal biometric system. Single image of hand which contains multiple features such as palm print, finger geometry, and finger knuckle, finger prints. By taking this advantage that single image gives multiple characteristics such system has been introduced in the literature by Zhu Le-qing [1].
Fingerprint is one of the widely used biometric traits. It is one of the oldest of all biometric traits. Fingerprint contains dark lines and white line in some pattern form which is unique for each person. Finger ridges are dark lines which are contained in image of fingerprint where white lines are called valleys. Friction ridges of human finger are impression of fingerprint. Minutiae are point where ridges are suddenly combined [2]. Result of any biometric system is depending on captured image so its specification differs for different biometric traits. In case of captured image of fingerprint is said to be good one when 25-80 minutiae points are present in image. There are classification of matching of fingerprint is takes place on the basis of ridge, valleys, such as correlation and minutiae based techniques [2, 3].
Palm print of person is another biometric trait which is widely accepted by people for identification purpose becomes input for biometric system which is used for identification and verification purpose. But palm prints are more reliable than finger prints since prints on palm are more distinctive than prints on fingers. So, those distinctive lines give more information [4]. The distinctive lines presented on palm are Principle lines, ridges and wrinkles. These properties of palm are genetically dependent but we cannot say same about other attributes. Biometric traits of identical twins are same which are not distinguish with help of unimodal biometric system. In case of palm print, in feature extraction stage features are extracted after preprocessing. These features are later compared with templates which are stored already. Gabor filter, wavelets are edge detection techniques used for feature extraction method.
Because of anatomy of fingers, fingers can move flexibly. And also, fingers can bend forward that is in palm direction but opposes in backward direction, which results in pattern formation. Different people has different pattern formed on dorsum surface of hand but unique for individual one. This individuality can be used for person identification purpose. So, this new approach of biometric trait, finger knuckles of hand dorsal surface is investigated by Ajay Kumar et al [13] for person identification. The another approach where two biometric traits are combined and build a multimodal biometric system which gives better accuracy results such as finger vein and finger print image are investigated[14]. Unimodal biometric system has its own limitations respective to their biometric traits which are used in that system. But in combination of multiple biometric traits gives more accurate, robust results. On other hand approach based on finger knuckle is successfully investigated by Kumar, senior member [17], the likelihood of employing minor finger knuckle images for the identification. The coarse-to-fine segmentation strategy developed has been quite self-made because it has been able to achieve higher matching accuracy.

III. OBJECTIVE

Objectives of proposed system are: To build such system which identified person as well as verify whether the person who is going to be identified is alive or not. For identification part biometric system is used which has features such as

prominent accuracy, robustness in nature, highly reliable results. This biometric system efficiently uses multiple biometric traits acquired from person's hand image. These biometric features are finger knuckles print, finger geometry and palm prints.

Proposed system efficiently uses KNN classifier and hierarchical method to employ to match multiple features for efficient hand recognition in a large database and at decision level AND rule fusion is used for feature matching purpose. A system also builds aliveness detection system for elimination of spoofing with help of PIR and thermal sensors which verifies person's aliveness.

IV. PROPOSED SYSTEM

The proposed system is said to be divided in two parts as identification part which carried out by proposed biometric system which is shown in figure 2 and verification part is done by aliveness detection system which is shown on figure 3.

As shown in figure 2 block diagram describes proposed identification biometric system. This system uses for input multiple biometric traits as three features of hand image. Such as finger geometry, finger knuckles, and palm print. These features fused at decision level, so as to improve the matching efficiency as well as recognition accuracy.

We propose here such system which considers multiple hand features as biometric traits and adopt different classification methods in a hierarchical manner to facilitate a coarse-to-fine handmetric matching for personal identification.
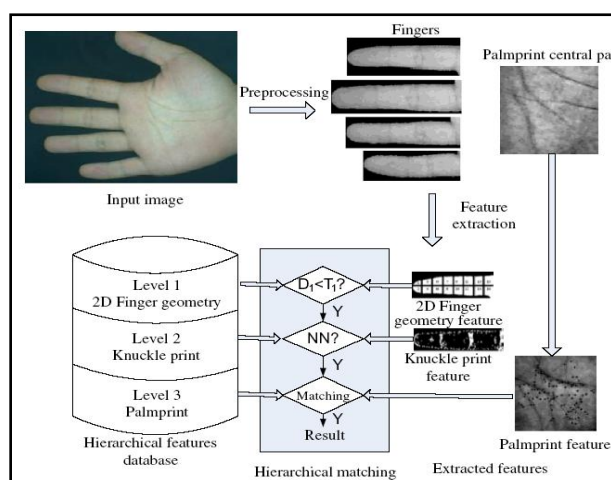

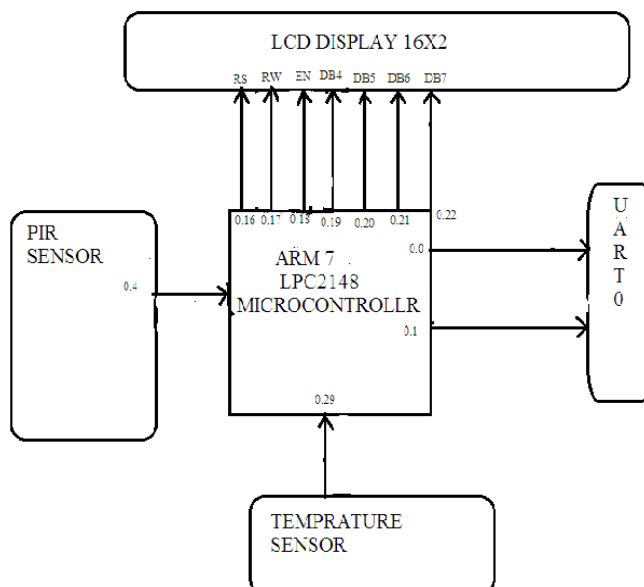Figure 2: Block diagram of proposed multimodal biometrics

Figure 3: Block diagram Of Aliveness Detection System

Fig. 1 illustrates the general structure of our system. The geometrical feature of four fingers is considered a Level-1 feature, the knuckle print of four fingers as Level-2 feature, and final level feature is palm print. The features in the hierarchical feature database are retrieved and compared with input features, in a multilevel fashion.

Figure 3 represents verification part of proposed system which is aliveness detection system. It contains two sensors. Thermal and PIR sensors where PIR sensor recognizes human hand motion where as thermal sensor detects hand temperature. Analysis of these two sensor's readings verification can be achieved which reveals whether the person is alive or not.

V. METHODOLOGY

In system identification of person is done by biometric system which has all modules as conventional biometric system. First step is image acquisition. Hand image is captured in image acquisition system which is build by three components as capturing box, camera, and light. Camera used in this system is web camera which has frame rate as 30 f/s. which is sufficient for real time requirement. The LED arrays are used for lighting purpose. The image acquisition system is shown in figure 6.

Hand Image Preprocessing:
In preprocessing stage initially, acquired image is rotated according to our requirement. Captured image is in RGB form so need to convert it into gray scale image for simplified calculations. With help of Ostu binarization image is converted in to binary image. By applying some morphological operations unwanted noise is removed and boundaries of hand are tracked. With the use of finger tips and valleys which are hand extremities are located so that ROI of fingers and palm can get. This can be done by tracking radial distance to a reference point which is located around wrist region. This extremities and reference point (WR) is shown in figure 4
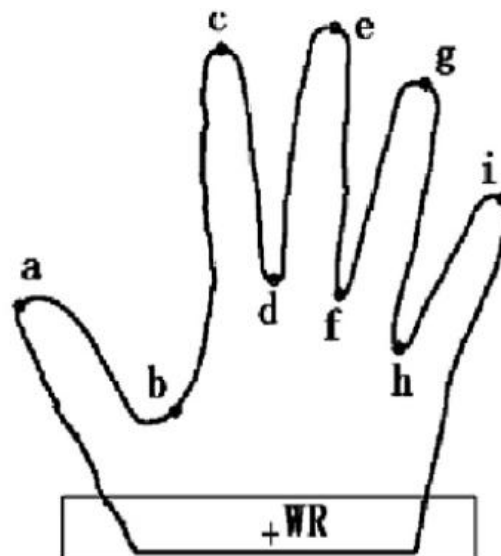

Figure 4: Locating fingertips and valleys

To extract ROI of palm pivots of index and little fingers are connected as K2K5 to consider as Y axis as shown in figure5.Them considering center as O of K2k5 and setting up the coordinate system.

Feature Extraction:
Feature extraction is very essential part in security biometric system, it influences on final result of recognition process. So, it becomes difficult and use one of hand feature for hand matching purpose. Use of multiple hand features gives high performance which can be seen in terms of accuracy, robustness and efficiency.

Here, in system we are using three features of hand; one of them is figure geometry which is length, mean width and N dimension finger shape vectors of four fingers (little, index, ring and middle).

By considering finger contour mean width is computed. The flexion shrinks in the inner skin of fingers is referred as knuckles. Main two features of knuckles print are the location of the lines and the patterns of each line. The gradient along vertical lines on front knuckle surface will reflect the knuckle print location trait and similarly, the vertical projection of the gradient will carry the width information of the lines. The processed gradient projection vector is enough for matching purpose.
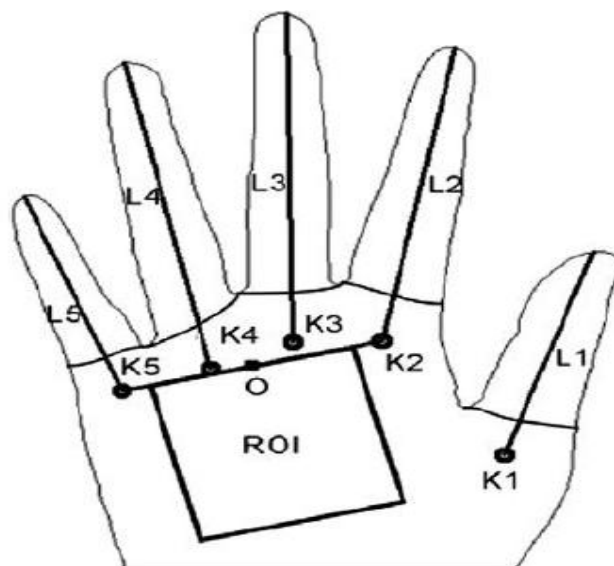
Figure 5: Finger and palmprint ROI extraction

Because of hand image captured with the web cam which has low resolution sharpness of image is low because gray values are changes slowly. So, difficulties are occurred in extracting no. of corner points of palm with Harris detector. To overcome this problem here, KLT corner detector is used, which gives plenty of corner points as per our requirements.

Hierarchical handmetric matching:
Matching of feature is done by KNN classifier.
In matching phase initial search is done in Level-1 for best matching subset of similar of finger geometry. As Level-2 which is knuckle print is searched similar as Level-1. Level-3 is of palm print is searches at end.

Second part of system is aliveness detection is done by with help two sensors as PIR sensor and Thermal sensor. The block diagram shown in figure 3 gives idea about system design. This system is placed in image capture box. When the person is get to be identified by giving his hand image at that time we are going to get readings of both sensors as PIR got no movement of person and if thermal sensor got readings which are below than 30 degree that means that person is dead. This avoids spoofing in biometric. System becomes more trust worthy.

VI. IMPLEMENTATIONS AND RESULT

GUI for personal identification is shown in figure9. First image in GUI is result of preprocessing stage as grayscale image. Second image shows extracted features, blue lines represent valleys and finger knuckles of hand. Square box draws with red lines are presented ROI of palmprint. Third image shows keypoint in palm image."Result" in GUI represents Person's identity.

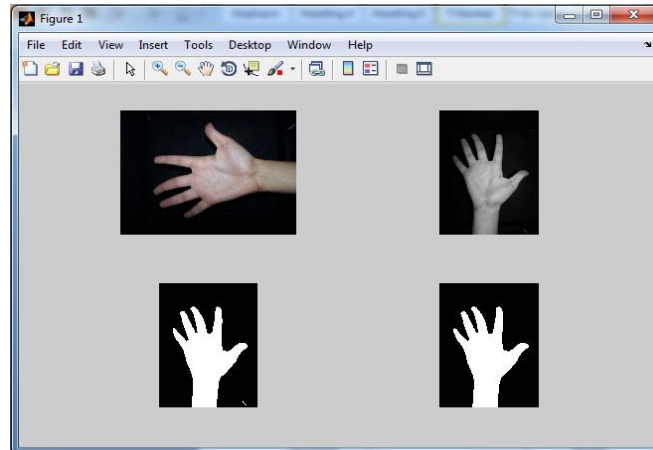Figure 6: The hand image capture device
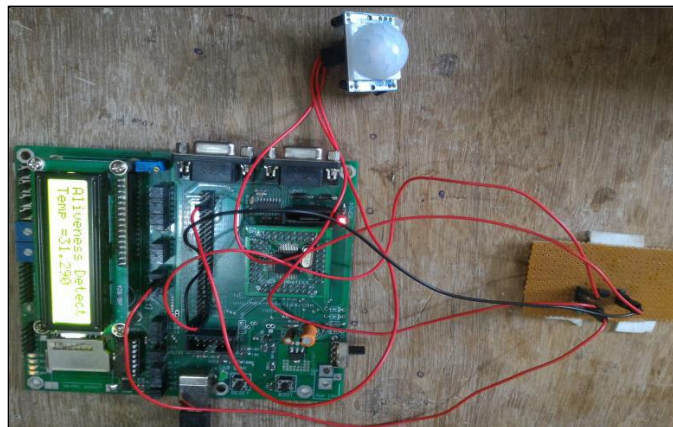
Figure 7: Preprocessing Results

Figure 8: Hardware Implementation of aliveness detection system

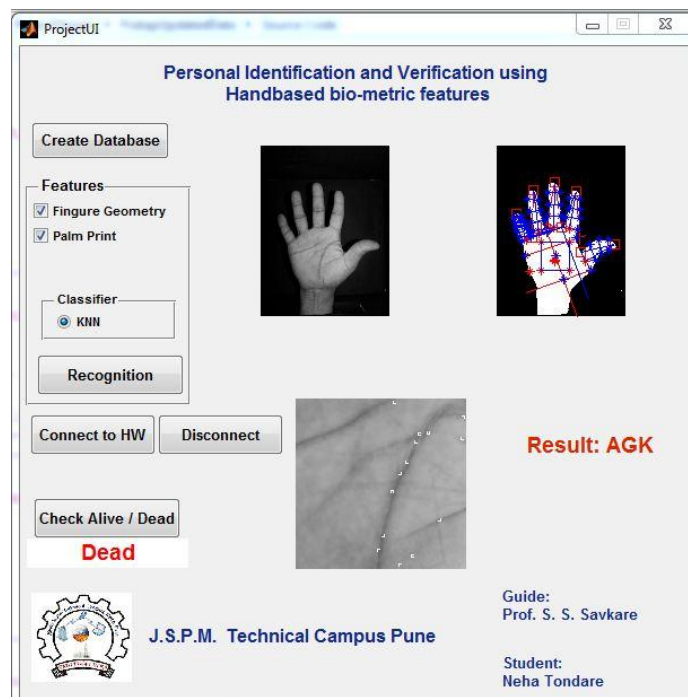In figure 8 LCD display shows result of aliveness detection system.

Figure9: Snapshot of Personal Identification

VII. CONCLUSIONS

This system eliminates drawbacks and enhances the characteristics of unimodal system. By using single hand image one can get three biometric features which are used effectively as biometric traits required for system which results in beneficiary in terms of cost effective system. This system also gives proof of aliveness of person by using thermal as well as PIR sensor. So system becomes spoof free.

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