Millimeter-Wave Person Recognition System using Hybrid Features & SVM Classification

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Abstract— Human Recognition is hastily improving in day-to-day life. Digital Image Processing (DIP) is a rapidly evolving field with blooming applications in Science and Engineering. The accuracy of human recognition system is mostly affected by varying lighting conditions. Due to the ability of millimeter waves (mmWs) to penetrate dielectric materials, such as plastic, polymer, and clothes, the mmW imaging technology has been widely used for the detection of concealed weapons and objects.The use of mmW images has also recently been proposed for biometric person recognition to overcome certain limitations in image acquisition at visible frequencies. The biometric recognition module of this work aims to perform person recognition through body shape-based and texture information extracted from GLCM using SVM classification. This project proposes a biometric person recognition system based on the shape information extracted from mmW images and texture feature extraction using Gray Level Co-occurrence (GLCM) technique is proposed. Extracted features are applied to SVM Classification technique for accurate person recognition from millimeter wave images. Experimental results suggest the potential of performing person recognition through mmW imaging using only shape information, a functionality that could be integrated in the security scanners deployed in airports.

Key words: Human Recognition, Weapons Detection, Millimeter Wave Image (mmW), Contour Feature, Gray Level Co-occurrence Matrix, SVM Classification

I. INTRODUCTION

Among many types of waves, the mmW waves have been recently found to have interesting properties for various pattern recognition applications. It lies between the super high frequency band, and the infrared band which is also referred to as the terahertz gap.

Millimeter waves (mmWs) are high-frequency electromagnetic waves in the range of 30 300 GHz with wavelengths between 10 to 1 mm. The use of mmW imaging in particular has been gaining interest in the security research community mainly due to its low intrusiveness and the ability to pass through clothing and atmospheric occlusions. Traditional applications of this technology include concealed weapon detection (CWD).Radiation at the mmW frequencies is non-ionizing and is therefore considered safe for human exposure. As a result, mmW scanners have been deployed in several international airports, replacing the former X-rays scanners. The suitability of these frequencies for CWD relies on the different response (due to difference of temperatures) between metallic objects and the human body skin.

Research in mmW imaging has focused in increasing the Research in mmW imaging has focused in increasing the narrow depth of field (distance over which an object is considered in focus) and the screening time of mmW imaging systems, in order to perform CWD through a corridor without creating bottlenecks. Automatic detection of concealed weapons, explosives, and contraband through mmW imaging is still an active area of research In the area of biometric person recognition, some researchers have studied the use of images acquired beyond the visible spectrum (e.g. X-ray and infrared (IR)) with the aim of overcoming the limitations such as illumination variations and body occlusions.

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Fig. 1.1: Millimeter Wave Images

II. PROPOSED SYSTEM

The proposed frame work of the person identification including the shape feature (contour)and texture feature done by the Gray Level Co-occurrence Matrix(GLCM).These feature extraction is done using mmW Images. Millimeter Images datasets are taken from the Bio-Giga database and TNO database. From this Image the extracted features are applied to the SVM classification for person authentication and not authentication. Figure 1.2 shows the system architecture for extracting the hybrid features from the mmW images and SVM classification algorithm is used for finding out the authenticated and not authenticated Persons. The feature extractors are unigrams with weighted positive and

negative keywords. This framework allows us to easily try out different combinations of classifiers and feature extractors. The proposed framework shows the following modules.

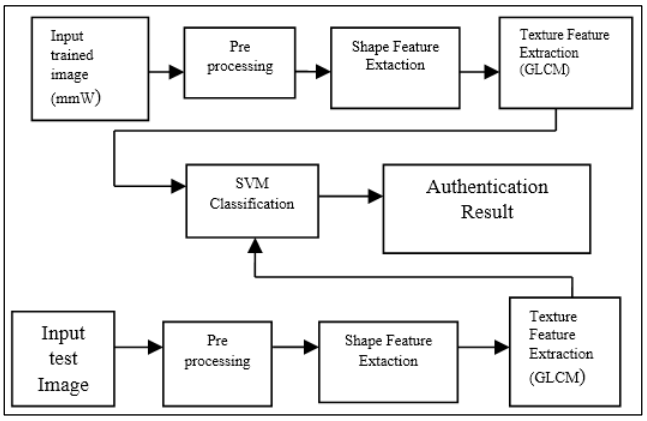

Fig. 2.1: System architecture

A. Pre-processing

It is a common name for operations with images at the lowest level of abstraction. Both input and output are intensity images. The main aim of pre-processing is to improve the image data and supresss unwanted distortions or enhances some image features important for further processing.

1) Binary Conversion:

A binary image is a digital image that has only two possible values for each pixel. Typically, the two colors used for a binary image are black and white. The color used for the object(s) in the image is the foreground color while the rest of the image is the background color. In the document-scanning industry, this is often referred to as "bi-tonal". Binary images often arise in digital image processing as masks or as the result of certain operations such as segmentation, thresholding, and dithering. B.Shape Feature

Edge detection includes a variety of mathematical methods that aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges. Edge detection is a fundamental tool in image processing, machine vision and computer vision, particularly in the areas of feature detection and feature extraction. Then the image will be segmented using contour segmentation. The shape feature contour is used to find out the boundries of mmW images.

a) Canny edge detection:

Canny edge detection is a technique to extract useful structural information from different vision objects and dramatically reduce the amount of data to be processed. It has been widely applied in various computer vision systems. Canny has found that the requirements for the application of edge detection on diverse vision systems are relatively similar. Thus, an edge detection solution to address these requirements can be implemented in a wide range of situations. The general criteria for edge detection include:

1) Detection of edge with low error rate, which means that the detection should accurately catch as many edges shown in the image as possible
2) The edge point detected from the operator should accurately localize on the center of the edge.
3) A given edge in the image should only be marked once, and where possible, image noise should not create false edges.

B. Texture Feature

One of the simplest approaches for describing texture is to use statistical moments of the intensity histogram of an image. Using a statistical approach such as co-occurrence matrix will help to provide valuable information about the relative position of the neighbouring pixels in an image. The GLCM or Gray Level Co-occurrence Matrix is a tabulation of how often different combinations of pixel brightness values (grey levels) occur in an image. Once the GLCM is created various features can be computed from it. In order to estimate the similarity between different gray level co-occurrence matrices, Haralick had proposed 14 different statistical features extracted from GLCM. To reduce the computational complexity, only some of these features are selected in this paper, specifically: Energy, Contrast, Homogeneity and Correlation.

C. SVM Classification

Image classification analyzes the numerical properties of various image features and organizes data into categories. Classification algorithms typically employ two phases of processing: training and testing. In the initial training phase, characteristic properties of typical image features are isolated and, based on these, a unique description of each classification category, i.e. training class, is created. Based on the Contour and GLCM texture features extraction of the mmW image, the SVM classifier classifies which is authenticated and not authenticated.

III. RESULTS & DISCUSSION

The proposed frame work of the person identification including the shape feature (contour) and texture feature extraction using a GLCM technique. These feature extraction is done using mmW Images. Millimeter Images datasets are taken from the Bio-Giga database and TNO database. From this Image the extracted features are applied to the SVM classification for person authentications and not authentication.

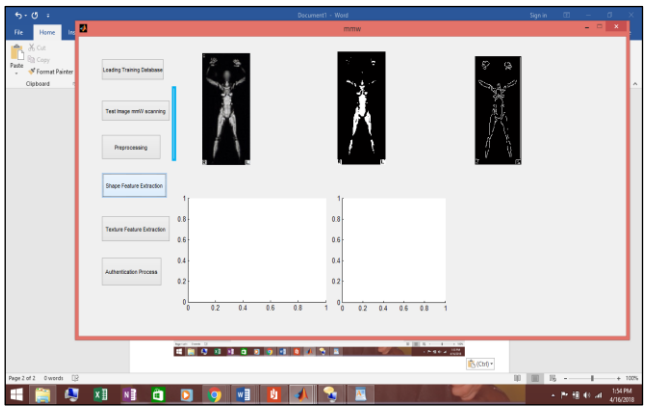

Fig. 3.1: Shape Feature Extraction

Figure 3.1 shows initially testing the Input Image mmW Scanning in that the preprocessing step takes the input

as mmW image and the given input Image is Gray Scale Image that is converted into the binary image. Binary Image processing actually simplifies the processing overhead and time latency. Then the Image is segmented and Edge is detected. From that the shape feature contour get obtained. It will be used to find the boundaries of the objects in the image.

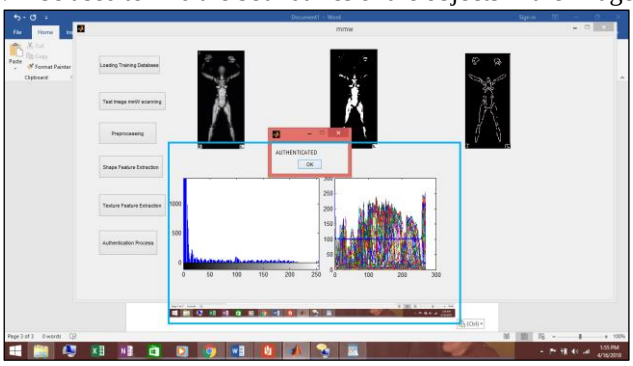

Fig. 3.2: sTexture Feature Extraction

Figure 3.2 shows the result of Texture Feature Extraction of the given test image by Gray-Level Co-occurrence Matrix (GLCM) texture. Certain Features such as such as contrast, correlation, energy, homogeneity are get obtained through GLCM technique. From these extracted features that are applied to the SVM classifiers. The SVM classifiers claasifies which person is authenticated and not authenticated.

IV. Conclusion and Future Work

The use of mmW images has been recently introduced in computer vision applications such as weapon detection and biometric person recognition applications. This is the first work addressing the problem of person recognition through body-shape information using real mmW images.

MATLAB Software use for this analysis Day by day research work is increasing in this field and various image processing techniques are implemented in order to get more accurate result. The proposed system is worked effectively for extracting feature of mmW Image taken from TNO database and Bio-Giga database. The Gray Level Co-occurrence Matrix (GLCM) method is used for extracting four Statistical Texture Parameters i.e., Energy, Contrast, Homogeneity and Correlation. By extracting the features of an image by GLCM approach, the image compression time can be greatly reduced in the process of converting Gray level image to binary conversion. In this technique, the authentication of mmW Image is described by applying image processing. Basically four features are extracted such as contrast, correlation, energy, homogeneity from the mmW image.

GLCM is a statistical method of examining texture that considers the spatial relationship of pixels so the local difference is calculated for exact discrimination of persons. So that more true acceptance rate is obtain due to hybrid features, more accuracy due to machine learning classifier and also GLCM speed the processing time. In future, application based system shall be designed to get proper result wheather mmW image is recognized or not recognized.

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