Volume 5, Issue 10, October-2015 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

User Authentication Using Lip Movement as a Password

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Abstract: ***This paper presents a system developed for face recognition and converting lip movement of an individual into a pattern which will be used as the password for authentication of the individual. It provides secure and voice-less password that involves lip-reading and syllable-identification techniques [1] thereby increasing the security of the system. With multiple levels of image processing i.e., face recognition and Lip reading recognition it becomes possible to set the matching parameters to a very close value, hence not allowing any brute force or other infamous hacking techniques to break into the user's system. Face recognition technique uses Weber's law & Gaussian Filter method and for Lip reading technique DWT Algorithm is used. This lip reading technique also serves applications in areas where communication via direct speech is not possible and control of external devices like, controlling the ROBOT is made possible.***

Keywords: Face Recognition, Lip Movement based Password, Zigbee Module, Web Camera and Robot

I. INTRODUCTION

The main objective is to provide secure and voice-less method for recognition of speech-based commands using video without evaluating sound signals. Nowadays there is an essential need to determine or verify the identity of a person where biometric security stands out as the most secured form of authentication in high security zones such as defence, space missions and research headquarters. The existing systems are sensor based alarm systems that are implemented using CCTV cameras. Finger Print Recognition and Face recognition are also emerging techniques but there can be fake biometric flaws.

Today, forms of password protection range from face recognition to retina scan. This paper presents the recognising and converting lip movement of an individual into a recognized pattern using image processing, as in [1,2]. It provides a break-through for a robust and easy way of protecting the data of people who have motor disabilities.

A) Goal:

Face recognition based authentication systems detect the face in the scene and it is cropped, followed by normalization for translation & scale. This normalized face image is then fed to the face recognition module in order to verify the identity of the person. The main focus of this work is to track the lips in the given face image and then extract suitable features from the lips to perform the differentiation task. Tracking lip motion in image sequences accurately and robustly is especially difficult because lips are highly deformable, and they vary in shape, colour and size in relation to surrounding features of individuals.

B) Motivation:

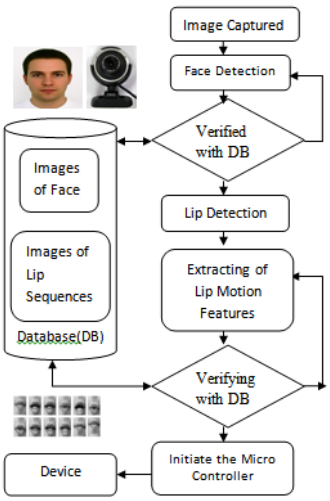

Figure 1: Implementation Block Diagram

The acoustic speech signals may probably be the most natural modality to achieve speaker verification. Although a purely acoustic-based speaker verification system has shown the effectiveness in its application domain, its performance would be degraded dramatically in the environment corrupted by the background noise or multiple talkers. Hence converting lip movement of an individual into a pattern which will be used as the password for authentication of the individual provides secure and voice-less method for recognition of speech-based commands using video without evaluating sound signals.

II. APPROACH

Providing a high level security in commercial offices for identifying the authorized person involves more than the best choice of technique and features. Depending on the application context, the identity of a person can be resolved in two ways a) Verification and b) Identification. To identify a person, Face Recognition Technique is used and to control the robot movement lip recognition technology is used.

A) Face Recognition Technique:

Face recognition for its easy use and non-intrusion has made it one of the popular biometric. A number of algorithms have been proposed for face recognition which can be divided into two categories a) Geometric feature based and b) Appearance-based. In appearance based methods the captured features are global features of the face images and facial occlusion is often difficult to handle in these approaches. Geometric feature based are robust against variations in illumination and viewpoints but are very sensitive to extraction process.

Recognition of faces from still images or 2D images is a difficult problem, because the illumination, pose and expressions change in the image thus creating great statically differences and the identity of the face itself becomes shadowed by these factors. To overcome this problem 3D face recognition has been proposed which has the potential to overcome feature localization, pose and illumination problems, and it can be used in conjunction with 2D systems. The captured image has to be normalised to identify the person by using Weber's law through Gamma Correction and Gaussian filter.

1. Weber's Law: Weber's law tends to break down for very dark and very bright luminance levels. At very low luminance, detector noise, and ambient light tend to reduce sensitivity, so the stimulus appears "black", as in [6]. At very high luminance, the very bright background tends to saturate detector sensitivity, thereby reducing sensitivity by blinding the subject based on the parameter used in gamma correction and Gaussian filter. The contrast sensitivity is approximately independent of the background luminance and relative changes in luminance of object are important.

2. Gamma Correction: The signal is said to be gamma corrected because it is pre-distorted to display. The input/output relationship for this imaging system undergoes through Gaussian filter.

3. Gaussian Filter: Characteristics of the Filter of the impulse response from the up-sampled input signals is $H(t) = (\exp(-t^2/2ð^2)/\sqrt{2\pi}.\ ð$. Where, $ð = \sqrt{(\ln(2))}\ /2\pi BT$ and B is the filter's 3-dB bandwidth. The BT product parameter is B times the input signal's symbol period.

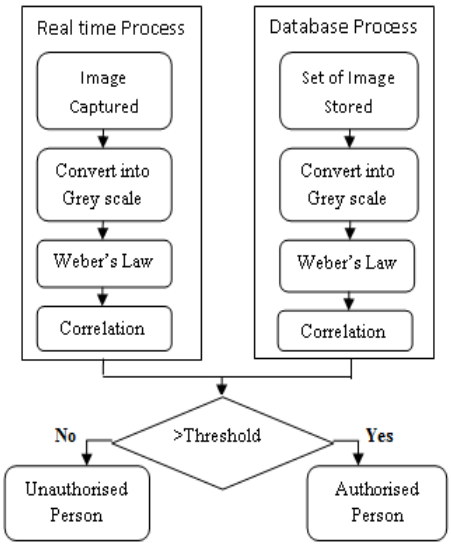

Figure 2: Flow of Face Recognition Technique

B) Lip Movement Recognition Technique:

The images are converted to black and white binary format to avoid the dissimilarities in colour hues and intensities. A sequence of images of the user is acquired using web camera. The Loaded image is compressed by applying the transform-The compression algorithm starts by transforming the image from data space to wavelet space, which is done on several levels. Threshold is chosen in such a way, as to preserve a certain percent of the total coefficients and perform compression at different transform like Haar-Wavelet for implementation in a still image compression system. The performances of these transforms are compared in terms of Mean squared error (MSE) and Energy Retained (ER) etc. This is implemented in software using MATLAB Wavelet Toolbox and 2D-DWT technique. [8]

1. Haar Wavelet Transformation:

A Haar wavelet, as in [7, 8] is the simplest type of wavelet. In discrete form, Haar wavelets are related to a mathematical operation called the Haar transform. The Haar Wavelet Transformation is a simple form of compression which involves averaging and differencing terms, storing detail coefficients, eliminating data, and reconstructing the matrix such that the resulting matrix is similar to the initial matrix, is discontinuous, and resembles a step function. The Haar transform serves as a prototype for all other wavelet transforms. Like all wavelet transforms, the Haar transform decomposes a discrete signal into two sub-signals of half its length. One sub-signal is a running average or trend; the other sub-signal is a running difference or fluctuation. Haar used these functions to give an example of an orthonormal system for the space of square integral function on the unit interval [0, 1].

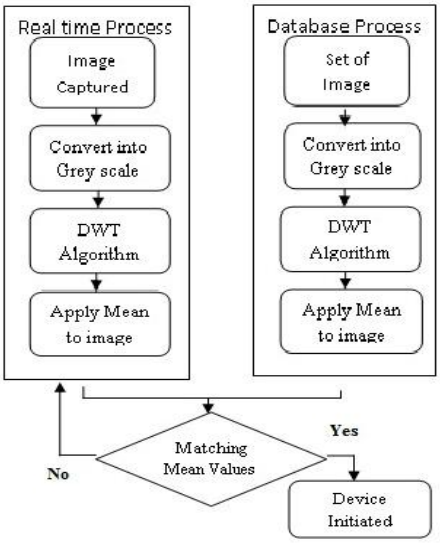

Figure 3: Flow of Lip Movement Recognition Technique

III. DESIGN AND IMPLEMENTATION

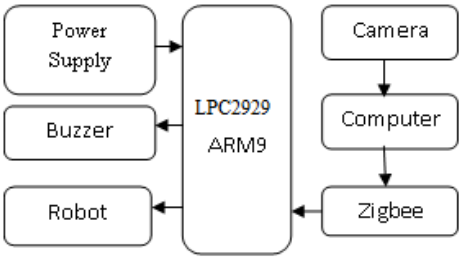

Figure 4: Hardware Block Diagram

The block Diagram contains Micro Controller (ARM9), L293D Driver, Buzzer, Zigbee Module, Webcam and PC. The person's image is captured and identified as an authorised or unauthorised person through PC. If authorised the micro controller is initiated through Zigbee Module and the external device Robot is accessed by activating the motor by device driver. If the Person is unauthorised the buzzer alert is initiated.

A. Hardware Implementations

1. Micro Controller ARM9:LPC2929: The LPC2929 combines an ARM968E-S CPU core with two integrated TCM blocks operating at frequencies of up to 125 MHz, Full-speed USB 2.0 OTG and device controller, CAN and LIN, 56 KB SRAM, up to 768 KB flash memory, external memory interface, three 10-bit ADCs, and multiple serial and parallel interfaces in a single chip. To optimize system power consumption, the LPC2929 has a very flexible Clock Generation Unit (CGU) that provides dynamic clock gating and scaling.

The input of the microcontroller is from PC through Zigbee Module and the result of the data is displayed in PC and L293D driver which initiate motor to rotate.

2. Zigbee Module: The XBee/XBee-PRO RF Module, as in [5] is designed to operate within the ZigBee protocol and support the unique needs of low-cost, low-power wireless sensor networks. The modules require minimal power and provide reliable delivery of data between remote devices. The modules operate within IEEE 802.15.4 standard. The data rate is 250kbps at 2.4GHz. Distance range to 10 -100 m line of sight

3. Camera: A Webcam is a video camera that feeds a stream of images in real time through the computer. It can capture Max 14Mega-Pixel in-built with a microphone image control and colour saturation adjusts.

4. Robot: The robot contains L293D driver which drives the motors in order to move in directions Left, Right, Front and Back.

5. DC motor: DC motor is a linear motor used to rotate clockwise or anti-clockwise based on the L293D driver initiates.

6. ***L293D Driver:*** L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors. L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction.

B. Software Implementation

1. MATLAB: MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. Typical uses include Mathematical computation**,** Algorithm development, Data acquisition Modelling, simulation and prototyping Data analysis, exploration, and visualization Scientific and engineering graphics Application development, including graphical user interface building.

2. Visual Basics: Visual Basic (VB) is the third-generation event driven programming language and integrated development environment(IDE) from Microsoft for its COM programming model. Visual basic enables the rapid application development (RAD) of graphical user interface(GUI) applications and access to databases using Data Access Objects scripting language used is VB Script.

Figure 5: Visual Basic

IV. FLOW CHART

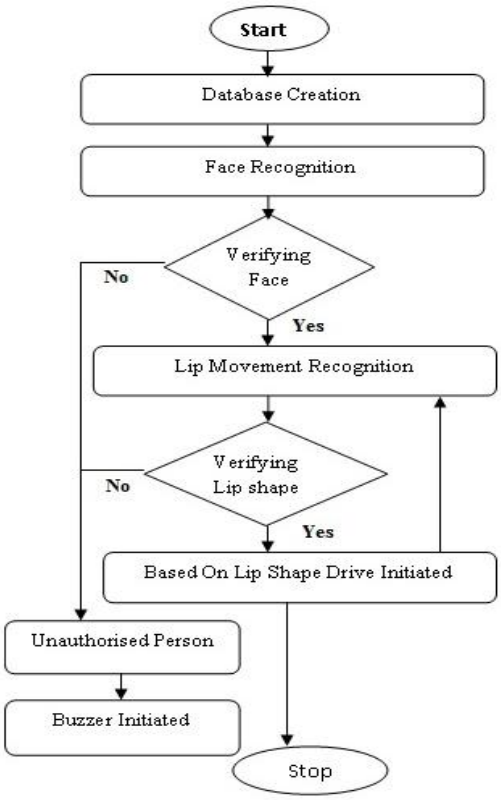

Figure 6: Flow Chart

V. RESULTS

Person has to undergo face recognition process and lip movement to access the device like Robot.

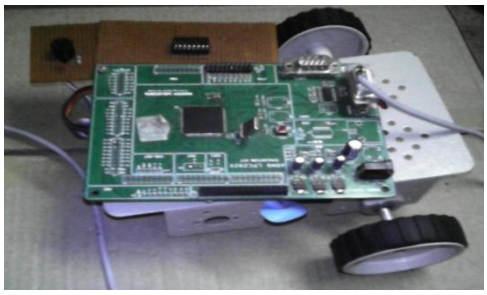

Figure 6: Robot Unit

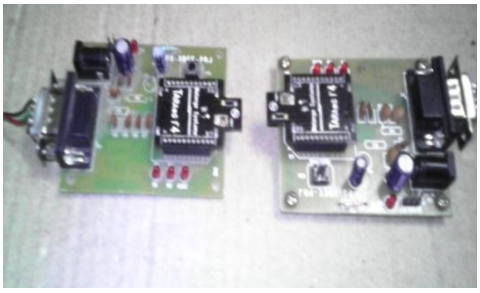

Figure 7: Zigbee Module

If the person is unauthorised, buzzer is activated and "Unauthorised person" message is displayed. If the person is authorised in face recognition & then undergoes through lip recognition then the robot can be controlled by using Arm9 based LPC2929 Micro Controller, Zigbee wireless Communication.

Figure 8: Identified as Unauthorised Person

Figure 9: Identified as Authorised Person

Based on the lip shape or lip contour the device is driven Left, Right, Front or Backward.

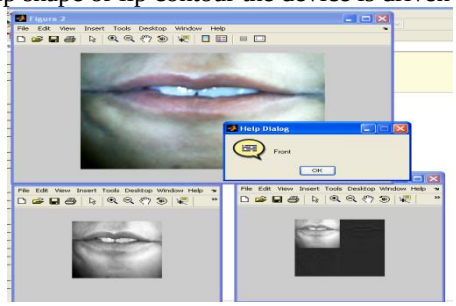

Figure 10: F-Shape Robot Moves Front

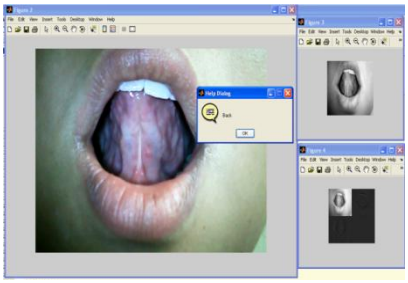

Figure 11: L-Shape Robot Moves Back

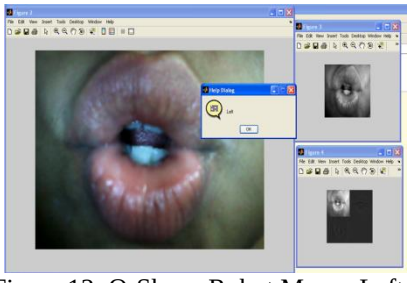

Figure 12: O-Shape Robot Moves Left

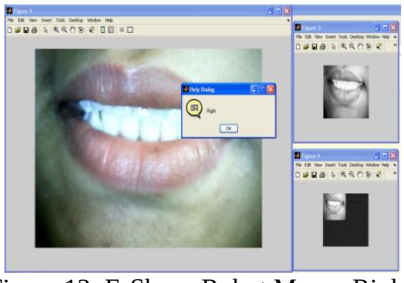

Figure 12: E-Shape Robot Moves Right

VI. CONCLUSION

This paper focuses on face recognition and lip movement based identity authentication system. It is mainly designed for disabled person, who can easily access their device based on voice-less lip movement authentication system. This system may be used in Security applications, Commercial applications, Industrial applications and Bio-medical applications.

VII. FURURE SCOPE

As the technology advances demand for more secure systems arises. Present biometric technology using face and Lip movement are not sufficient so a new visual feature representation incorporating the outer lip contour and inner mouth features may be introduced to perform recognition experiments.

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