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Human Gait Authentication with AVR Using Labview

Gurmeet Kaur
ECE & PTU
Punjab, India

Baljinder Kaur
ECE & PTU
Punjab, India

Munish Kumar
Inst. & P.U
Punjab, India

Abstract -- Biometrics identification methods have been in use for a very long time. The reason being the biometrics recognition is very secure. Also every person has unique biometric characteristics. The term Biometric is derived from a greek word. Bio means life , and metric means to measure. This paper presents a new method for verifying a person's identity. Here one of the behavioral biometrics i.e. the Gait pattern of Human Being is used. A wearable device mounted with Accelerometer is used to collect data for Gait analysis. This Accelerometer will detect leg's movement in horizontal, vertical and sideway direction. After detecting the movement in all the axes the data is fed to the microcontroller's A/D pins and then with the help of LabVIEW a person's Gait pattern is acquired.

Keywords-- Biometric Authentication, Gait, human movement, Accelerometer, Sensors, Bluetooth, Pattern recognition.

1. Introduction

Security has always been a major concern in today's world. From the past, many methods have been advised to beef up the security like password security, security tokens, smart cards but these are not always a fool proof approach. The only fool-proof approach advised is the bio-metric Authentication. It is hard to forge or spoof. Common biological characteristics used for enterprise authentication are fingerprints, palm , iris features, and hand geometry ,voice or face, Gait(walking style)patterns. Biometric recognition forms a strong link between a person and his identity because biometric traits cannot be easily shared, lost, or duplicated. In this thesis work, Gait as a biometric feature is used. Gait pattern has proved itself to be the best method for verifying a person's identity. Gait was first used by Johansson [1]. This paper is organized as follows. In section 2 different biometric methods are discussed. In section 3 which technology is used to achieve the work is mentioned. Section 4 discusses about the main Project. Chapter 5 is about Discussion and Conclusion and Chapter 6 is the acknowledgment and last chapter 7 is about references.

1.1 AUTHENTICATION

Identity verification i.e. Authentication is a technology with the increasing importance in today's life. There are three different ways in which a system can authenticate a person. And these are explained below:

1. To Possess something: It is something you have i.e. the possession of specific items or tokens like keys, smart card, identity card which lead to authenticate a person's identity. But the main drawback of this type of authentication is that it is more costly than the other schemes. Secondly it is not a secure way of authenticating a person because the possession or the smart cards etc. can be stolen or replicated.
2. To have Knowledge of something: It is about something you know. The knowledge of a secret like PIN code, Password for web sites, online banks. Networks and telecommunications also rely on secrets etc. In [6] Stallings has described about the knowledge based authentication in which user password selection methods are discussed.
3. Biometric i.e. To be something: biometrics is about something you are. It is a characteristic which are exhibited by someone. Through this type of authentication basically we recognize each other in this world. In Biometrics, specific characteristics of a person like Finger print, IRIS, Retina, Gait, Typing speed are included.[10]

2 Biometric

Biometric is the study of intrinsic biological traits to uniquely identify the individuals [7]. To automatically confirm a person's identity Biometrics has often been used. Biometrics is of two types:

Physiology characteristics cannot be changed easily because these are the inherent properties of the body like DNA, IRIS, Retina, Fingerprints, Face Recognition etc. and Behavioral biometrics are the learned characteristics of a person for example: Gait (human walk), signature, typing rhythm, mouse usage, sounds etc.

2.1 Gait Biometric

Gait is the study of human locomotion i.e. how a person walks or runs. Or we can say that walking is a series of Gait cycles. A single Gait cycle is defined as the Period when one foot contacts the ground to when that same foot contacts the ground again.

Weight acceptance is the main task of Gait cycle which involves the transfer of body weight on to a limb that has just finished swinging forward & has an unstable alignment.

A Gait pattern i.e a human locomotion can be collected in three different ways and are mentioned below:

Machine Vision Based
Floor Sensor based
Wearable sensor based.

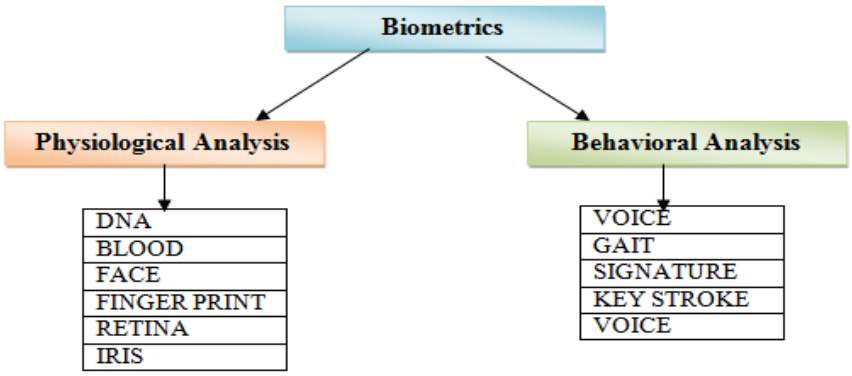

Fig 1 Types of Biometric System

Machine Vision was mainly used as Gait Biometrics in the very early stages. Niogi and Adelson made the very first effort in 1990s in developing Machine Vision based Gait recognition. The main advantage for this type of recognition compared to other Biometric Systems is that persons are captured unobtrusively from a distance. Even though MV-based Gait analysis is not that precise as other Biometrics, example finger prints. But it is still useful.
Floor Sensor can be installed on the floor or the mat and the Gait patterns are measured when a person walks on the floor or the mat.
Wearable Sensor based is the recent Gait recognition method than the explained above. In Wearable Gait patterns the accelerometers are used which detect the human locomotion in X, Y, Z direction. To compare with the other methods WS is a very cheap method of Gait analysis and on the other side FS and MV based sensors are very expensive because the camera and floor equipments are involved. Furthermore WS based technique is mobile. It is used to verify a person's identity.

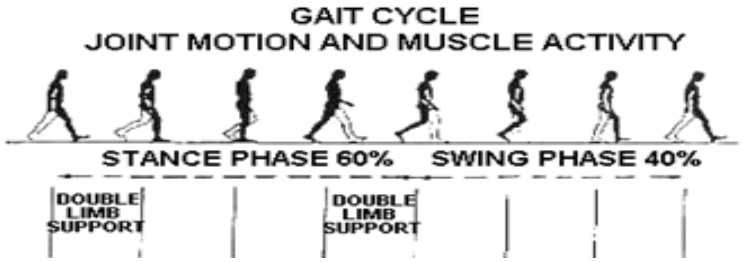

Fig 2 Gait Cycle

- There are some other parameters also which determine the gait pattern like the Stride Length which is the distance covered in 1 gait cycle, Cadence that depends upon no. of steps taken per unit time and velocity that is the combination of both Cadence and Stride length. A Stride has two phases:

Stance Phase: It is the time when foot is in contact with the ground.
Swing Phase : It is the time when foot is not in contact with the ground.

3. Technology Used

To use Gait as Biometric System following components are required:

- Sensor
- Controller(Algorithm)
- Transmitting Module
- Data Storage
- Matching Algorithm
- Decision Process

3.1 Accelerometer Sensor
MMA 7361 Accelerometer is used to get the human walk-pattern in X-Y-Z direction. It is a three axis Micro-Machined Accelerometer (analog) with dimensions 3mm*5mm*1mm of Free Scale Semi-conductor. This Accelerometer has two sensitivities of $\pm 1.5g$ and $\pm 6g$. At 1.5 g, 800mv/g sensitivity is observed. This break out board works in voltage range of 2.2 to 3.6 Volt optimal at about 3.3 Volt and consumes 400mA current. This data will be used for authentication at LabVIEW using AVR ATmega16 microcontroller with the help of RN-42 blue tooth module.
3.2 Block Diagram of Whole System

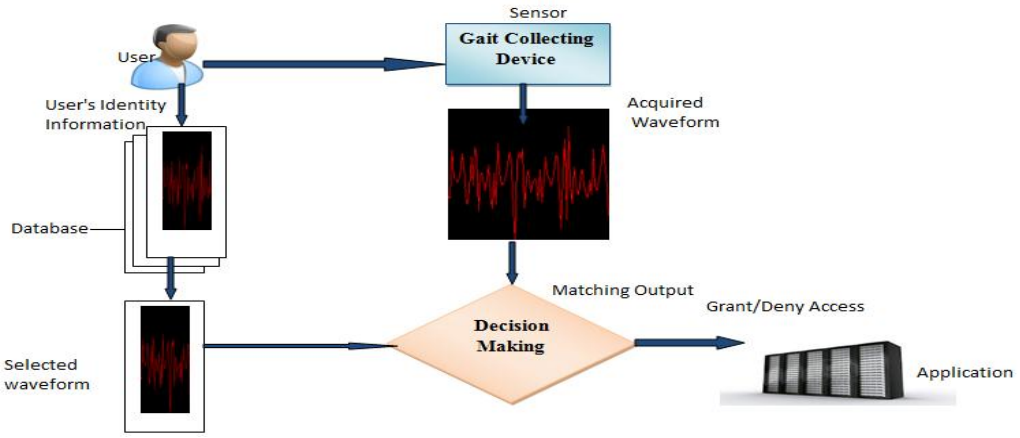

Fig 3 Block Diagram of whole system

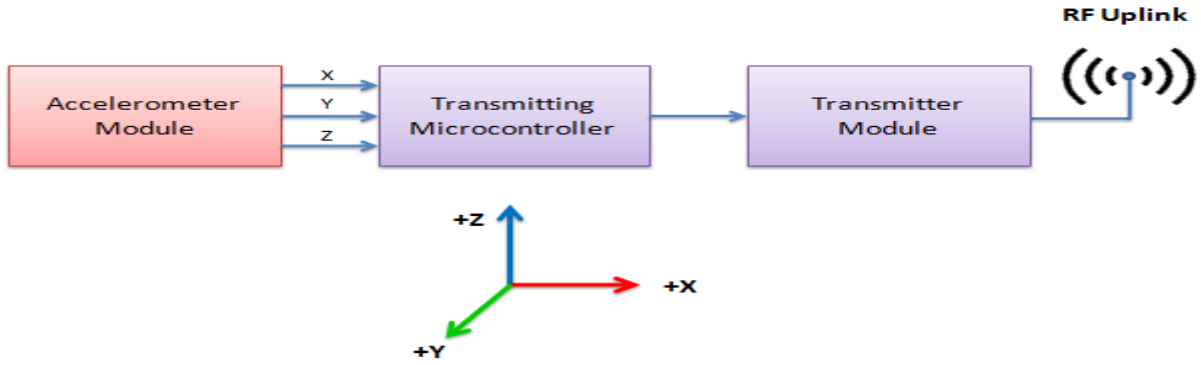

Fig 4 Block Diagram of Transmitter Module

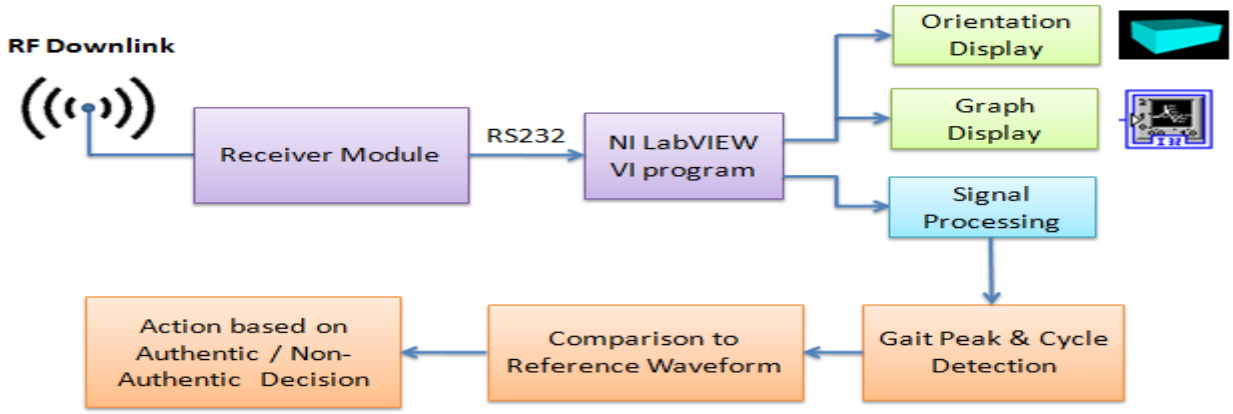

Fig 5 Block Diagram of Receiver Module

To acquire the data for verification of the person's Gait pattern with the stored pattern LabVIEW is used. Data is acquired on LabVIEW with the help of microcontroller ATMEL AVR Atmega16. This microcontroller is of High Performance, Low Power, Advance RISC Architecture with 32*8 general purpose working registers.

3.2 Data Acquire Technique (LabVIEW)

The reason behind choosing LabVIEW (short for Laboratory Virtual Instrumentation Engineering Workbench) is that it helps us in creating complicated applications in a short time. The graphical language is named "G" and released for the Apple Macintosh in 1986. LabVIEW is commonly used for data acquisition, instrument control, and industrial automation on a variety of platforms. There is no text based code as such, but a diagrammatic view of how the data flows through the program. LabVIEW programs are called virtual instruments, or VIs, because their appearance and operation imitate physical instruments, such as oscilloscopes and multimeters.

4. Project Discussion

4.1 Code for the Work Done

The data will be acquired by the LabVIEW serially using VISA serial port in which VISA resource name uniquely identifies the resource to be opened and read data from. The data is sent at 9600 baud rate. The string of data will be read by using VISA Read. The read data will be compared with the reference value and that string will be converted to number, this number can be displayed on dial and graph. The complete block diagram to acquire the Gait pattern on LabVIEW is as shown in fig 6.

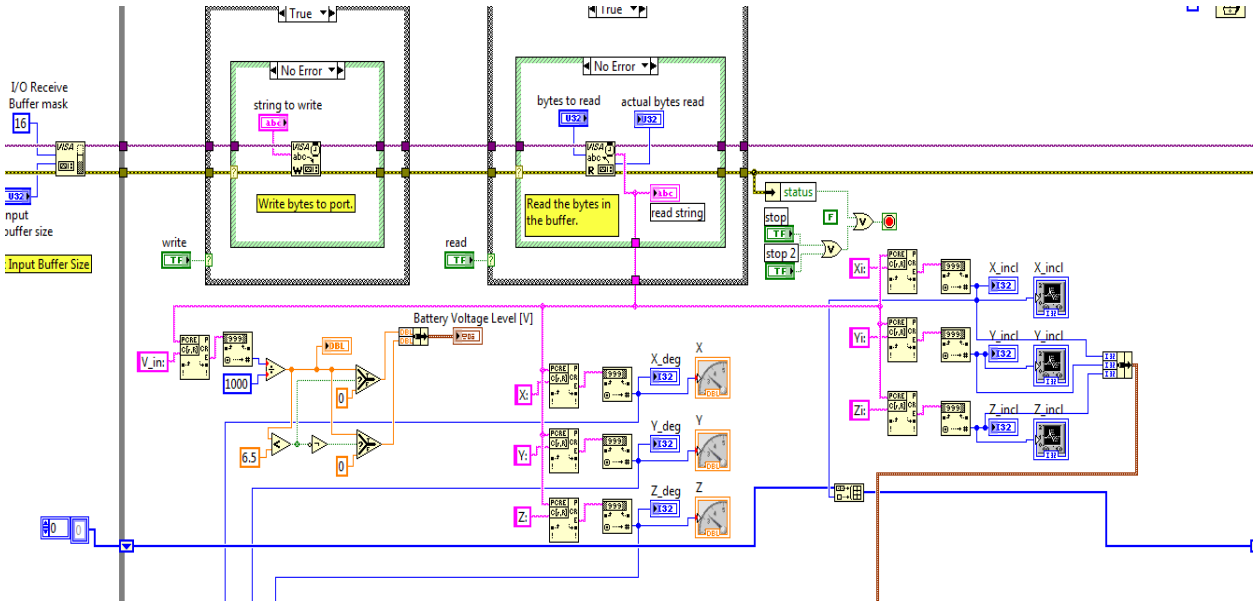

Fig 6 Block Diagram to acquire Gait Pattern on LabVIEW

4.2 Output

MMA 7361 Accelerometer will sense the human movement in the three axes. This data will be read by VISA read in the LabVIEW and the read data can be plotted as the wave forms using LabVIEW. The waveforms for the three subjects in X, Y, Z axes are shown below in fig 7:

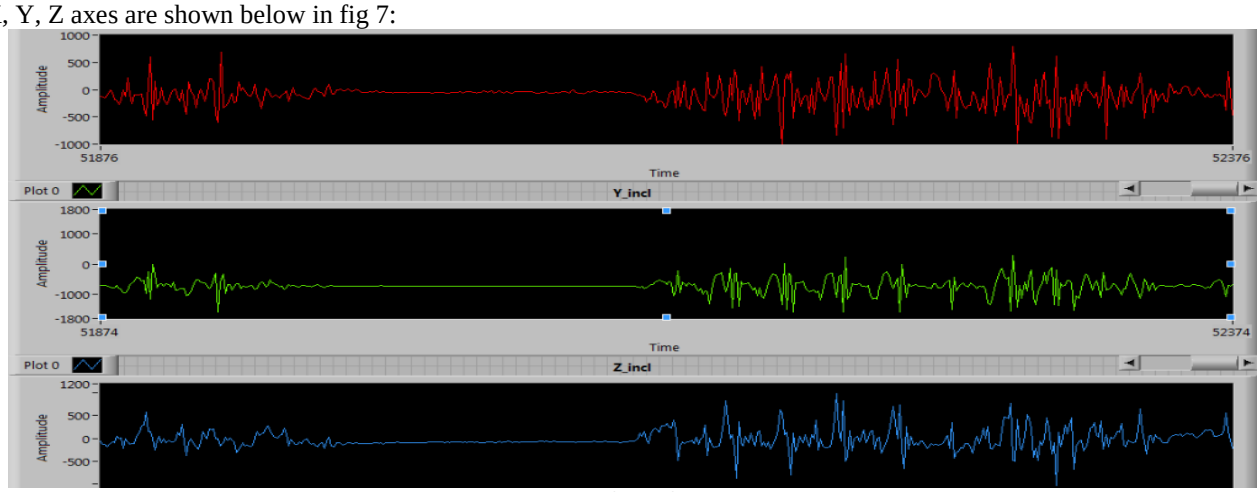

Fig 7(a) Waveforms for Subject 1

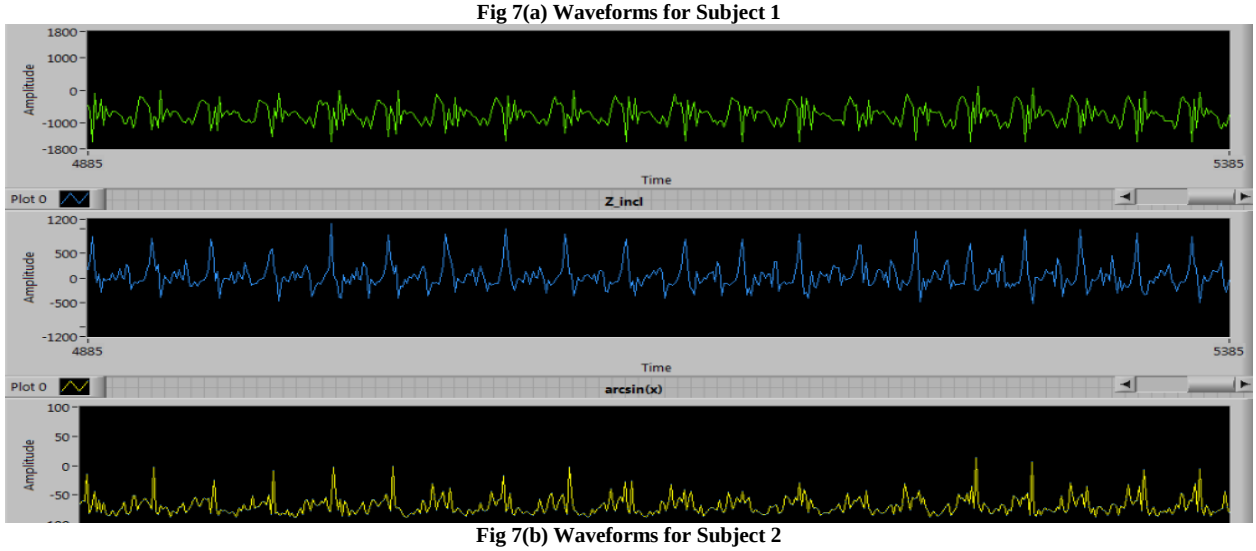

Fig 7(b) Waveforms for Subject 2

Fig 7 waveforms of data acquired by LabVIEW

5. DISCUSSION AND CONCLUSION

In this way the movement of a person in X, Y, Z axis is acquired by the LabVIEW. The waveforms for the three subjects are entirely different from each other. So Gait biometric can be used as an authentication system because each subject has

a unique Gait style. To make this authentication system successful, a user need to take care of certain factors like the footwear used, floor on which he is walking and walking speed.

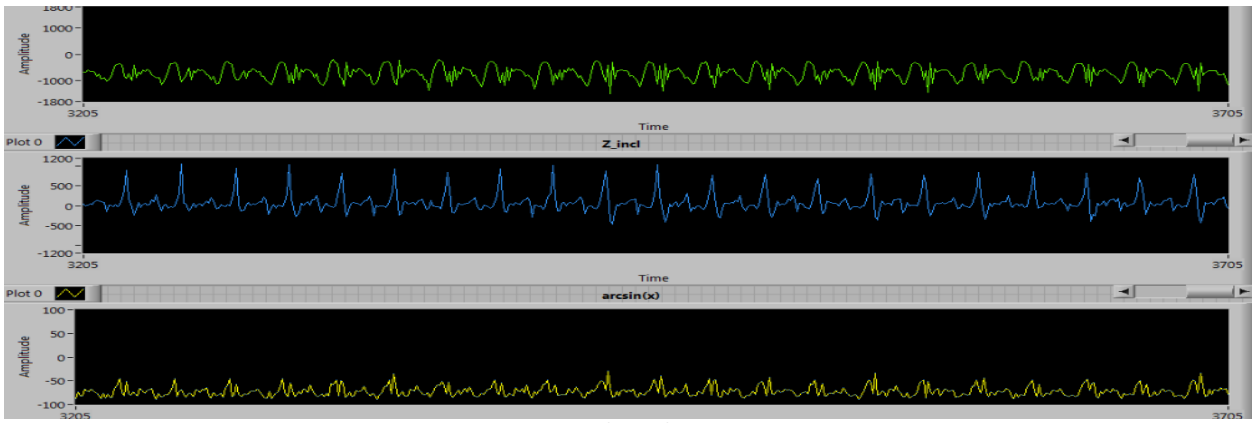

Fig 7(c) Waveforms for Subject 3

6. ACKNOWLEDGEMENT

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