

# Fingerprint Based Attendance System

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**Abstract:** The term 'biometrics' refers to a measurable characteristic that is unique to an individual such as fingerprints, facial structure, the iris or a person's voice. This paper presents a fingerprint based biometric system that records the attendance of a person by using a hand held fingerprint sensor. The experimental results suggest that many fraudulent issues can be overcome using the fingerprint based attendance system and improves the reliability of the attendance records.

**Keywords:** Biometric, Fingerprint, Attendance, Optical sensor, Arduino.

## I. INTRODUCTION

Attendance is a concept that exists in different places like institutions, organisations, hospitals, etc. during the start and end of the day to mark a person's presence. In early days and even now in many places attendance is recorded manually in attendance registers by calling out the names. This results in waste of time and human effort. Also there are many fraudulent issues that happen when we use a register. For example, in educational institution, the teacher calls out the names of the student's one after the other and marks their presence after they answer.

The other way that is followed is the teacher passes the attendance sheet around the class for the students to sign besides their names. But these methods have a major drawback where the students tend to answer or sign for their friends who are not present for that day. These fraudulent issues may become more frequent if the class strength is high.

A solution to overcome these problems is by using a system that will record the attendance automatically. In this direction, this paper presents a fingerprint based biometric system that records the attendance automatically. This system consists of a fingerprint sensor which is used to detect the person's identification. For example, in educational institutions, the student needs to place their finger on the fingerprint sensor to obtain their attendance. The fingerprint captured is recorded in a flash memory and then each time it is checked whether the obtained fingerprint matches with the record in the flash memory after which the student gets the attendance. By making use of this system, we overcome the issues such as proxy so no student can give attendance for their friends who are absent.

The paper is organised as follows. Section II is about related work which describes on different biometrics used in attendance management system. Section III gives a brief system overview which describes about the various components in the proposed system. Section IV presents the system architecture and describes about the modules in the proposed system. Section V describes the experimental results of the proposed system. Section VI concludes the paper.

## II. RELATED WORK

In [1], the author presents a survey of various developments in fingerprint sensor technologies with respect to their strengths and weaknesses. Related issues on technology, underlying physics, Liveness detection, resolution, performance assessment, limitations and standardization are discussed. A clear tendency on adding new hand based traits in order to increase the performance of the hand based biometric scheme, an experiment that combine hand geometry, palm print, finger texture and vein pattern of hand is presented in [2]. The work in [3] emphasizes on the technical details and performance comparison of various available fingerprint sensors and explores the future direction and system development that states using similar techniques for Chance or latent fingerprint enrolment. [4] briefs the biometrics technology by using a hand held device for attendance. The device can communicate with a host computer using its USB interface. This device operates from a rechargeable battery. The research in [5] uses the social survey method questionnaire to evaluate the theory and practice of introducing biometric recognition technology-hand geometry capturing into the attendance management system. [6] Presents a system of recording student attendance using fingerprint identification that allows students to monitor student attendance to class electronically. This attendance system displays attractive graphics and has the complete students' details using Microsoft Visual Basic Studio and integrated fingerprint reader.

## III. SYSTEM OVERVIEW

The proposed system uses an automatic attendance management technique that integrates fingerprint authentication into the process of attendance management. It comprises of two processes namely; enrolment and authentication. During enrolment, the biometrics of the person is captured and is stored in a flash memory along with the person's id. The objective of the enrolment module is to register the user using his/her id and fingerprints into a flash memory after feature extraction. During authentication, the biometrics of the user is captured and are compared with all those that already exists in the flash memory to determine a match. If a

match is found then attendance is marked against the person's id. A fingerprint reader shown in Fig. 1 is the input device. The flash memory comprises of fingerprint template and other details of the person.



Fig. 1 Fingerprint Reader

The components used in the proposed system are as follows:

**Optical Fingerprint Sensor (R305A)**

This is a fingerprint sensor module with TTL UART interface for direct connections to micro-controller UART or to PC through MAX232 / USB-Serial adapter. The user can store the fingerprint data in the module and can configure it in 1:1 or 1: N mode for identifying the person. The FP module can directly interface with 3v or 5v Micro-controller. A level converter (like MAX232) is required for interfacing with PC serial port. Optical biometric fingerprint reader has good features and can be embedded into a variety of end products, such as access control, attendance, safety deposit box, car door locks.

**Arduino**

Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures kits for building digital devices and interactive objects that can sense and control the physical world. Arduino boards may be purchased pre-assembled, or as do-it-yourself kits; at the same time, the hardware design information is available for those who would like to assemble an Arduino from scratch.

The present work is based on a family of micro-controller board designs manufactured primarily by Smart-projects in Italy, and also by several other vendors, using various 8-bit Atmel AVR micro-controllers or 32-bit Atmel ARM processors. These systems provide sets of digital and analog I/O pins that can be interfaced to various extension boards and other circuits. The boards feature serial communications interfaces, including USB on some models, for loading programs from personal computers. For programming the micro-controllers, the Arduino platform provides an integrated development environment (IDE) based on the Processing project, which includes support for C and C++ programming languages.

**LED Lights**

A light-emitting diode (LED) is a two-lead semiconductor light source. It is a PN-junction diode which emits light when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons.

This effect is called electro-luminescence, and the colour of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor. An LED is often small in area (less than 1mm<sup>2</sup>) and integrated optical components may be used to shape its radiation pattern.

**Connecting Wires**

The wires are used for connecting the fingerprint sensor to Arduino and from Arduino to the bread board. Only through these connecting wires, the power is supplied to the system and simultaneous operations are performed.

**Bread Board**

A breadboard is a construction base for prototyping of electronics. Originally it was literally a bread board, a polished piece of wood used for slicing bread. In the 1970s the solder-less breadboard (AKA plug-board, a terminal array board) became available and nowadays the term "breadboard" is commonly used to refer to these. "Breadboard" is also a synonym for "prototype". Because the solder-less breadboard does not require soldering, it is reusable. This makes it easy to use for creating temporary prototypes and experimenting with circuit design. For this reason, solder-less breadboards are also extremely popular with students and in technological education. Older breadboard types did not have this property. A strip-board and similar prototyping printed circuit boards, which are used to build semi-permanent soldered prototypes cannot easily be reused. A variety of electronic systems may be prototyped by using breadboards, from small analog and digital circuits to complete central processing units (CPUs).

**Serial Monitor**

The serial monitor is an interface that displays the messages for the user to perform the corresponding actions.

**IV. SYSTEM ARCHITECTURE**

The system architecture diagram is shown in Fig. 2. The design of the attendance management system using fingerprint based biometric system comprises of the following modules:

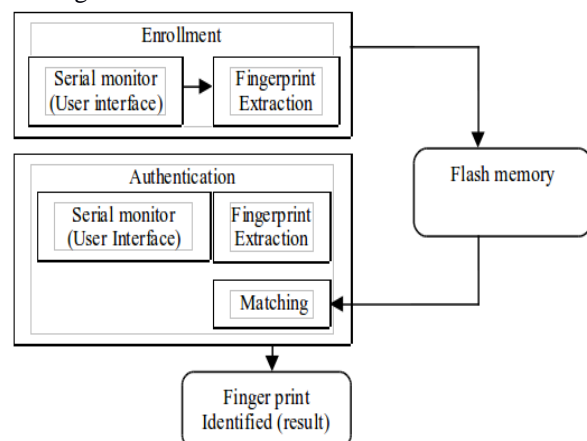


Fig. 2 System Architecture

### Enrolment module

This module performs the task of enrolling the person and their fingerprints into the system flash memory. During enrolment, the fingerprint and other details of the person are captured and unique features are extracted from the fingerprint image and stored in a flash memory as a template along with the person's ID.

### Authentication Module

The task of authentication module is to validate the identity of the person. The person to be authenticated indicates his/her identity and places his/her finger on the fingerprint reader. For the captured fingerprint image, the biometric template is extracted during the feature extraction stage. It is then fed to a matching algorithm which matches it against the person's biometric template stored in the system flash memory to establish the identity.

### Flash memory

During the enrollment process, the fingerprint enrolled with an id is stored in the flash memory in the Arduino. Hence during the authentication the fingerprint scanned is compared with all the fingerprints in the flash memory and if the match is found, the student will be marked present.

## V. EXPERIMENTAL RESULTS

The system has been tested by 50 students of a class and was found to work without any errors. This is a hand-held system by which the students gave their attendance. The system is reliable and avoids fraudulent issues. The attendance is viewed through a computer to check whether they are marked present or absent.

The 2D Gabor Filter algorithm is used for capturing and authenticating fingerprints. In image processing, a Gabor filter, named after Dennis Gabor, is a linear filter used for edge detection. In the spatial domain, a 2D Gabor filter is a Gaussian kernel function modulated by a sinusoidal plane wave. Image analysis with Gabor filters is thought to be similar to perception in the human visual system. Its impulse response is defined by a sinusoidal wave (a plane wave for 2D Gabor filters) multiplied by a Gaussian function.

Because of the multiplication-convolution property, the Fourier transform of a Gabor filter's impulse response is the convolution of the Fourier transform of the harmonic function and the Fourier transform of the Gaussian function. The filter has a real and an imaginary component representing orthogonal directions. The two components may be formed into a complex number or used individually.

Complex

$$g(x, y; \lambda, \theta, \psi, \sigma, \gamma) = \exp\left(-\frac{x'^2 + \gamma^2 y'^2}{2\sigma^2}\right) \exp\left(i\left(2\pi\frac{x'}{\lambda} + \psi\right)\right)$$

Real

$$g(x, y; \lambda, \theta, \psi, \sigma, \gamma) = \exp\left(-\frac{x'^2 + \gamma^2 y'^2}{2\sigma^2}\right) \cos\left(2\pi\frac{x'}{\lambda} + \psi\right)$$

Imaginary

$$g(x, y; \lambda, \theta, \psi, \sigma, \gamma) = \exp\left(-\frac{x'^2 + \gamma^2 y'^2}{2\sigma^2}\right) \sin\left(2\pi\frac{x'}{\lambda} + \psi\right)$$

Where

$$x' = x \cos \theta + y \sin \theta$$

And

$$y' = -x \sin \theta + y \cos \theta$$

In this equation,  $\lambda$  represents the wavelength of the sinusoidal factor,  $\theta$  represents the orientation of the normal to the parallel stripes of a Gabor function,  $\psi$  is the phase offset,  $\sigma$  is the sigma/standard deviation of the Gaussian envelope and  $\gamma$  is the spatial aspect ratio that specifies the ellipticity of the support of the Gabor function.

## VI. CONCLUSIONS AND FUTURE SCOPE

Biometric technology is an effective tool to verify identity and detect fraudulent issues. Analysis confirmed that the biometric data can be set and confirm the identity of the user. Expanding the use of biometrics will enhance the ability to detect fraudulent issues in the presence of the students in class or employees in an organization. In terms of efficiency and performance, the present work has provided a comparison with the traditional methods attendance system. By using the flash memory, the data is well structured. This system is user-friendly and very reliable. Therefore, it can be implemented either in organisations or educational institutions.

The attendance management system can be improved by adding the features that indicate if the employee or student is late. Some of the future enhancements for this are to extend the current flash memory to store the complete details of the student. The system can be enhanced to track the arrival and exit time of the student or employee for additional monitoring.

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