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Fingerprint Sensor Based Attendance System Using Raspberry pi

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Abstract : **The precision and ease of use of the BIOMETRIC Attendance System draw many users to it among the many real-time apps available today. The development of an attendance system based on fingerprints was a significant difficulty. This method proposes to use a Raspberry Pi running Linux as the attendance system. The procedure starts with the generation of the database using a fingerprint reader and continues with the system-provided recognition and authentication. The Raspberry Pi platform is used for the entire procedure. The standardized fingerprint authentication approach, which can extract an individual's finger print and compare it to a database, is presented in this study. Additionally, it can give parents and teachers a summary of attendance on a daily and monthly basis. The main goal of the study that follows is to use biometric systems for verifying and authenticating the physical attendance of inmates in any kind of organization. This is made possible by the working principle of biometrics, which is based on control of prominent scalability, flexible properties, and cost reduction for reducing the requirements of biometric systems for numerous computational resources.**

IndexTerms **- Fingerprint Sensor, Interfacing, Raspberry Pi.**

I. INTRODUCTION

One benefit of the human body is that each person has distinct characteristics. These special qualities are applied in the realm of biometrics and its security applications. Biometrics became widely used quickly and were shown to be a dependable method of protecting security and privacy. Numerous locations, including hospitals, offices, airports, colleges, and schools, can use this technology. The science of applying statistical analysis to biological data is known as biometrics. The fundamental and distinctive qualities of the characteristics are the primary biometrics issue. It encompasses a range of anatomical characteristics, such as the iris, face, veins, palm, fingerprint, and so on. In the context of security, precision and dependability are two crucial elements. Because of its precision and simplicity, fingerprint-based biometric systems are among the earliest and most extensively used biometric authentication methods. Since each person has a unique fingerprint, it is best to start with the model. Hospitals and other institutions use the idea of attendance to record a person's presence at the beginning and conclusion of the workday. The conventional method of taking A person, a register, and a pen are present during class attendance. This is a major disadvantage because it takes a long time to complete and allows for the manipulation of attendance. There's a possibility that some pupils will not reply to the attendance form and then begin to claim it. Therefore, the new process of taking attendance using fingerprints is simpler and gets over all of the aforementioned issues [1-2].

A fingerprint sensor is used to identify people by detecting their fingerprints. In order to retrieve their attendance records in schools and universities, students must place their fingers on the fingerprint sensor. After the students receive their attendance, it is then double checked against the records stored on the flash memory [3–4]. With the help of this system, proxy attendance problems are resolved, meaning that none of the students can sign up buddies who are missing. Python is the programming language and Linux is the operating system utilized in Raspberry-pi. If an employee or student is running late, it can also be indicated by the extra features in the attendance management system. Future system improvements could include adding more flash memory to the existing one so that all of the data can be stored there.

The technology is capable of tracking the student's or employee's arrival and leave times for further surveillance. Raspberry Pi has been used to design biometric architectures since it can connect via USB ports to cameras, fingerprint scanners, and other devices. The Raspberry Pi is employed in this study as a low-cost, wireless remote enrollment node, and software-as-a-service (SaaS) cloud hosting is an option for biometric authentication.

Authors have suggested a cloud-based face recognition system in [11]. The paper aims to expound on the topics like the ost frequent problems and barriers that arise while switching to a cloud platform, as well as guidelines and suggestions for biometrics and current solutions, cloud-based services, and both.

II. LITERATURE SURVEY

Sasse et al. [6] conducted an experimental investigation into the root causes of the password problem, including organizational and technical needs as well as memorability problems (e.g., being compelled to change passwords). The study found that practically all password issues may be resolved with Human-Computer Interaction (HCI) strategies.

Analogously, the security and memorability of passwords were investigated empirically by Yan et al. [7]. [9] evaluates the compatibility of a machine readable travel document (MRTD) system based on six criteria, including enrollment, redundancy, storage requirements, renewal, machine assisted identity verification requirements, public perception, and performance. Of the biometrics of face, finger, hand, voice, eye, DNA, and signature, the face biometric ranks first.

The authors of [10] demonstrated how to capture images using an embedded system built on Raspberry Pi boards. The majority of identification systems on PCs are constantly centered, and their portability is constrained by their large size, weight, and high power consumption. Implementation of fingerprint and footprint feature extraction on a Raspberry Pi has been discussed in [8]. Using an open-source CV library on a Linux platform, a Raspberry Pi is used to implement a variety of image processing algorithms. A Raspberry Pi cloud-based biometric architecture is suggested [14], which has helped create a low-cost, marketable, and portable biometric system.

Less labor is done in producing exam results reports and automatically sending them to parents along with attendance records, according to the literature review. The smart attendance system will create a record of the exam results for each student, construct an excel document with the results, and send it to the parent. Students' academic performance will benefit from this. A monthly report on attendance will be generated, and a daily analysis of the average attendance record will be conducted.

2.1: Problem Statement

Every business or organization places a high value on attendance, which is tracked on a daily basis. At many schools nowadays, pupils sign a sheet of paper with their name on it to record their attendance. This system's main flaw is that students can falsify their friends' signatures even when they aren't present. It takes a lot of effort and many staff working hours to keep track of the names and numbers of pupils who are in the class. In this article, we outline strategies for mitigating the current issue using our biometric attendance tracking system that generates customized reports.

Data is transmitted via Raspberry Pi, to which our hardware modules are linked. By comparing pre-registered data, the system offers two methods—the Fingerprint Module and the Facial Recognition Module—for recording attendance in a unique fashion. Following the recording of attendance, the system uses Firebase to transfer data to a real-time database, from which the web application can get it. Additionally, the system may produce customized attendance reports. Unlike other biometric attendance management systems now in use, our system offers a fully working backup mechanism to record attendance in the event that our primary method malfunctions or takes an excessively lengthy period.

2.2: Objective of proposed work

The primary goal of a biometric system is to verify and authenticate the physical presence of inmates in any kind of organization. This is based entirely on the principle of biometrics, which controls prominent scalability, flexible properties, and cost reduction to minimize the need for many computational resources in biometric systems.

III. PROPOSED WORK

3.1: Block Diagram

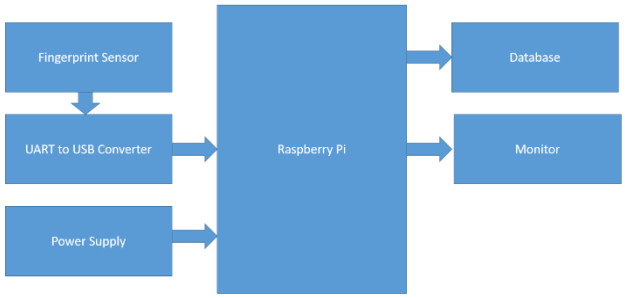

Fig 1 Block Diagram of Proposed System

Working of System:

1. **Fingerprint Sensor:** This is the primary input device for capturing the user's fingerprint. It scans and captures the fingerprint image.
2. **Image Processing Module:** This module processes the fingerprint image to extract key features, such as minutiae points, ridge patterns, and core points.
3. **Feature Extraction:** Feature extraction algorithms analyze the processed image and extract relevant features from the fingerprint, which are used to create a unique fingerprint template.

4. **Fingerprint Database:** The fingerprint templates are stored in a secure database for later comparison during the authentication process.
5. **Microcontroller or Microprocessor:** This unit serves as the central processing unit and manages the system's overall functionality.
6. **User Interface:** The user interface allows users to interact with the system. It may include a display, keypad, or a touchscreen for user input and feedback.
7. **Database Management System:** This component manages the storage, retrieval, and comparison of fingerprint templates with those stored in the database.
8. **Authentication and Matching:** The fingerprint template from the user is compared with stored templates in the database to authenticate the user's identity.
9. **Attendance Management:** If the user is authenticated, the system records the attendance, date, and time in a centralized attendance management system.
10. **Communication Module:** This module is responsible for data transmission, often connecting the attendance data to a central server or cloud-based system.
11. **Access Control (Optional):** If the system serves dual purposes, it can grant or deny access based on the fingerprint verification result.
12. **Power Supply:** This block ensures a stable power source for the entire system.
13. **Logging and Reporting:** The system may include a logging and reporting function to maintain records and generate attendance reports.

3.2 Hardware Specifications

3.2.1 Raspberry Pi 4*:* We may learn to program with the Raspberry Pi, an inexpensive, little computer that can be used for practical projects. Programming is a very demanding and enthusiastic subject. It's a tiny gadget that makes it easier for users to learn various programming languages, such as Python and Scratch, and to explore computing.

Fig 2 Raspberry Pi 4

3.2.2 Fingerprint Sensor*:* Human fingers are imprinted on the friction edges that leave fingerprints. Sweat, which originates from endocrine glands found in epidermal ridges, deposits them on surfaces. There may even be a discernible foot mark on friction ridges. Fingerprint records include impressions from the pad on the thumb and final joint of the fingers. This uses the R307 fingerprint module. The TTL UART interface on the system module allows it to be connected to a microcontroller via an RS232 serial bus. This module works with all types of operating systems. Even the Raspberry Pi's interface (running Debian OS) is simple.

Fig 3 Fingerprint Sensor

3.2.3 ***UART to USB Converter****:* Based on SiLabs' CP2102 Bridge, this module converts USB 2.0 to TTL UART. Even laptops without a normal serial port can use this module. With the use of USB, this module turns your computer into a virtual COM port that supports a range of common serial connection Baud Rates. Installing the driver is as simple as utilizing a setup file, which installs the necessary driver files for Windows XP, Vista, and 7. Install the driver and then insert the module into any available USB port on your PC. Finally, the PC has access to a new COM port. The TTL level data i/o is the characteristic that increases convenience.

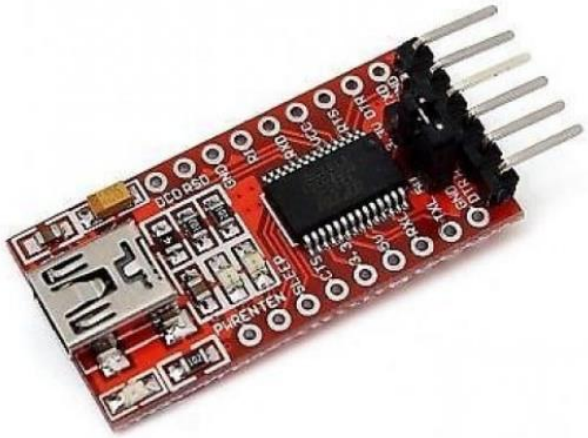

Fig 4 UART to USB Converter

IV. RESULTS AND DISCUSSION

4.1 Circuit Diagram

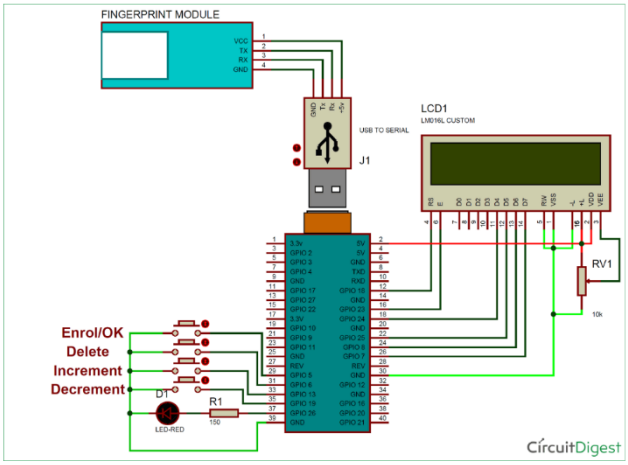

Fig 5 Circuit Diagram

4.2 Advantages

1. Lessen the labor of humans
2. Using technology to replace human labor.
3. Low price
4. Financial Resolution

4.3 Applications

1. In MNC
2. In school/Colleges
3. In library
4. In hospital

V. CONCLUSION

Because every student's academic record is kept up to date and their data is sent to parents for their benefit, this system is very helpful to Guardian Faculty Members, class teachers, and the corresponding parents. The suggested smart attendance system has real-time authentication capabilities. It is possible to find a solution for the proxy attendance issue.

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