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Raspberry Pi Enabled Biometric Attendance System

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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.

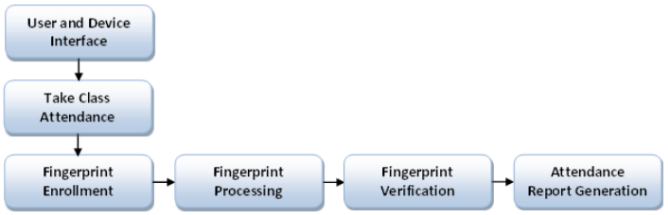
Key Words: Fingerprint Sensor, Interfacing, Raspberry Pi.

1.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.

2. Body of Paper

2.1 Block Diagram



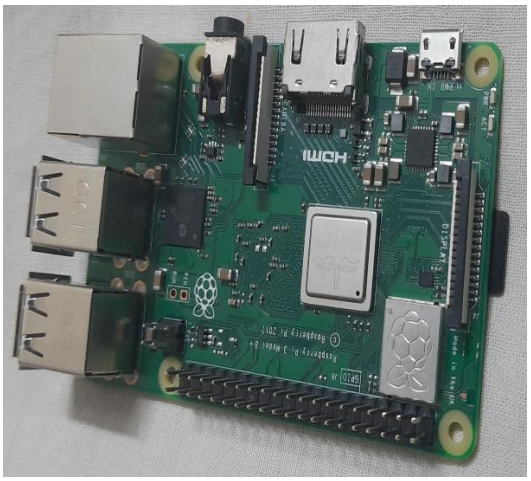
The fingerprint authentication system comprises several key components to ensure efficient and secure user identification. At its core is the fingerprint sensor, capturing the user's fingerprint image, which is then processed by the Image Processing Module to extract essential features like minutiae points and ridge patterns. These features

are further analyzed by the Feature Extraction algorithms to generate a unique fingerprint template, stored securely in the Fingerprint Database. A central Microcontroller or Microprocessor manages the system's operations, while the User Interface provides interaction points for users, employing displays, keypads, or touchscreens.

The Database Management System handles the storage, retrieval, and comparison of fingerprint templates, enabling Authentication and Matching against stored data. Upon successful authentication, the system records attendance data, including date and time, facilitated by an Attendance Management component, which can be further communicated to a central server or cloud-based system through the Communication Module. Optionally, an Access Control feature may regulate physical access based on verification results. Ensuring uninterrupted functionality, a Power Supply block provides stable power. Additionally, the system may incorporate Logging and Reporting functions to maintain records and generate attendance reports, enhancing administrative oversight and accountability.

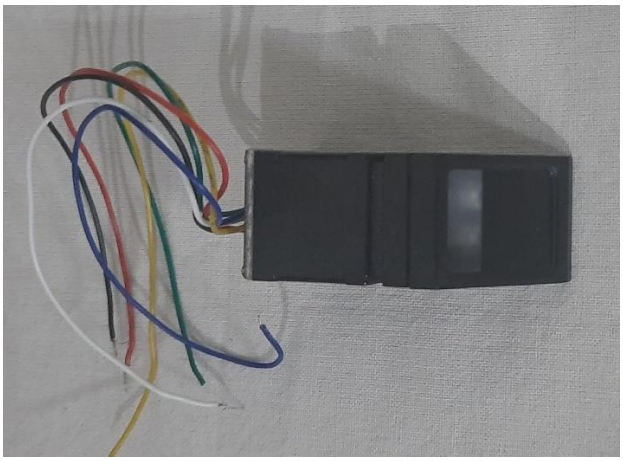
2.2 Hardware Description

1. Raspberry Pi:



Raspberry Pi is a versatile, credit-card-sized computer developed by the Raspberry Pi Foundation, a UK-based charity. Launched in 2012, it was created with the primary goal of promoting computer science education and providing an affordable platform for learning programming, electronics, and digital making. The Raspberry Pi has since gained immense popularity and has been used for various applications, from educational projects to industrial and commercial uses. Low-Cost Computing: Raspberry Pi is known for its affordability, making it accessible to students, hobbyists, and professionals alike. It offers a cost-effective solution for learning and prototyping. Small Form Factor: The compact and credit-card-sized design of the Raspberry Pi makes it highly portable and easy to integrate into various projects. Processing Power: Raspberry Pi models have evolved over the years, offering improved processing power. This includes CPUs, GPUs, RAM, and USB ports, allowing for a wide range of applications.

2. R307 Fingerprint Sensor:



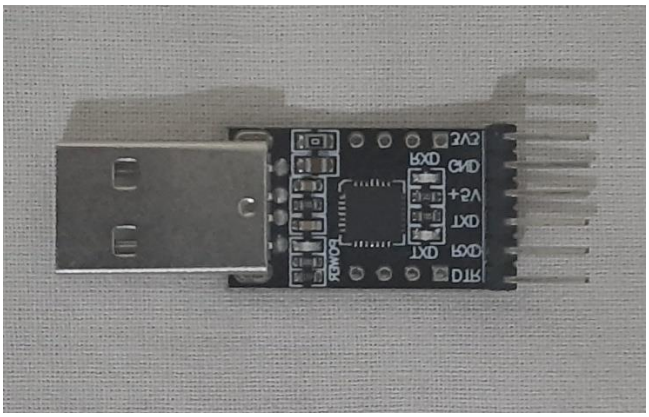
The R307 Fingerprint Sensor is a biometric fingerprint recognition module commonly used for various security and access control applications. This sensor is known for its compact size and ease of integration into different projects, making it a popular choice for hobbyists, developers, and businesses. R307 fingerprint module is a fingerprint sensor with a TTL UART interface for direct connections to microcontroller UART or to PC through MAX232 / USB-Serial adapter. The FP module can directly interface with 3.3 or 5v Microcontroller. A level converter (like MAX232) is required for interfacing with PC serial port.

Integrated image collecting and algorithm chip together, All-in-one Fingerprint reader can conduct secondary development, can be embedded into a variety of end products. Users can conduct secondary development, can be embedded into a variety of end products, such as access control, attendance, safety deposit box, car door locks. Low power consumption, low cost, small size, excellent performance, Professional optical technology, precise module manufacturing technics.

3. USB Cable:

For a fingerprint sensor-based attendance system that utilizes a USB connection, the USB cable serves as a crucial component for data transfer and power supply

4. **CP 2102 USB to TTL converter:**



The CP2102 USB to TTL converter is a versatile and compact device commonly used for connecting various microcontroller and embedded systems to a computer or other USB-enabled devices. It can play a crucial role in a fingerprint sensor-based attendance system for configuring and interfacing the fingerprint sensor with the host system.

5. I2C Module:

An I2C (Inter-Integrated Circuit) module plays a crucial role in a fingerprint sensor-based attendance system, particularly in scenarios where the fingerprint sensor or other components use the I2C communication protocol. I2C is a widely used serial communication protocol for connecting various devices in embedded systems and IoT applications.

6. LCD:

An LCD (Liquid Crystal Display) is a common output device used in fingerprint sensor-based attendance systems. It provides a visual interface for displaying information to users and administrators.

ACKNOWLEDGEMENT

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