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Face Recognition based Attendance Tracking System for Education Sectors

K. Preethi[1], Saipriya Chiluka[2], V. Bhavya[3], K. Praneeth Kumar[4], P. Vinay Krishna[5]

[1,2,3]UG Student, [4,5]Assistant Professor, Department of ECE
Kommuri Pratap Reddy Institute of Technology, Ghatkesar, Hyderabad, Telangana, India.

ABSTRACT

Currently, industries, organisations are using personal identification strategies such as RFID, Iris recognition, Fingerprint identification is used for taking attendance. Among of all these personal identification strategies including face recognition is most natural, less time is taken and highly efficient one despite being difficult to implement, a continuous observation for overcoming it. It has several applications in attendance management systems and security systems. In this work, a system is implemented that takes attendance for students using face detection and recognition technology. In the system a Raspberry Pi installed with OpenCV library and a Raspberry Pi Camera module is connected for facial detection and Recognition. The data is stored in the memory card connected to Raspberry Pi and it can be accessed.

Keywords: Face recognition, attendance tracking, Raspberry Pi, Open CV library.

1. INTRODUCTION

Personal identification is considered an important aspect in recognizing the identity of a individual. A person's identity can be validated through the traditional or biometric methods. There are two types of traditional methods which are token-based and knowledge-based identifications [1]. Examples of the token-based method include possession of a passport, driving license, and different types of cards such as identity (ID) card and credit card. Although it is convenient to carry these identity documents, these documents can be reproduced, stolen, or lost. On the other hand, the knowledge-based method is related to a password or personal identification number (PIN) created by everyone for authentication. Nonetheless, it tends to be forgotten easily, especially if the person has several passwords or PINs for different applications. Another alternative method is through biometric adoption, which considers the physical or behavioural characteristics distinctive to an individual. Physical characteristics refer to inherent features of the human body part. These include the face, fingerprints, and iris. On the contrary, behavioural characteristics deal with features observed from human action. Examples of human action are gait, voice, and signature [2]. By using biometric methods, the problems faced in traditional methods as mentioned above can be solved. Currently, biometrics are employed in a wide variety of domains. According to a 2018 report by German and Barber from the Center of Identity, University of Texas at Austin [3], the top three sectors which embrace biometric methods are financial services, technology, and government. This is followed by the workplace, recreation, and healthcare and with the least usage in the education domain. In financial services and technology domains, a person can use a mobile wallet to purchase goods. This is because most of the current mobile phones are integrated with a biometric scanner. By adding a credit card to a mobile wallet, payment for in store or web purchase can be done through Apple Pay or Samsung Pay. In Apple Pay [4], Face ID or Touch ID is used while Samsung Pay [5] utilized the fingerprint or iris for authentication. In addition, the banking industries are also adopting biometric measures to authenticate their customers at ATMs. For instance, almost 90% of the ATMs in Macau were installed with "Know-Your-Customer" facial recognition technology [6]. Asserting that facial recognition is less secure, Bank of China (Hong Kong) equipped the company's ATM with finger vein identification [7]. As of December 2017, 160 ATMs had been installed in all the branches in the city state. Governments all over the world are quick to adopt biometrics for different purposes. Malaysia is the world's first country to use an electronic passport with a thumbprint as the biometric security feature in 1998 [8]. Subsequently, the passport was further enhanced with

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an additional security feature using face recognition [9]. Other than that, the fingerprint is also incorporated inside the chip on the Malaysia's identity card, MyKad [10]. Over in China, a vast network of surveillance cameras enabled with face recognition technology was installed to help in criminal detection and law enforcement [11]. Moreover, several international airports are seeking to enhance efficiency and improve passenger experience by deploying biometric technology. Besides, the biometric processing of a passenger also helps the respective government in controlling border checkpoint security. Face recognition technology is employed in Singapore's Changi Airport [12] and Atlanta's Hartsfield-Jackson International Airport in the US [13]. A new "smart tunnel" check-in system using iris recognition was implemented in Dubai International Airport [14]. The workplace and education domains applied biometric technology for attendance recording or tracking [15–17], accessing permission [18, 19], and behavioural analysis [16, 20, 21]. Attendance records are used for an employee's payroll and to determine whether a student is eligible to sit for an exam. Access permission ensured that only authorized personnel can enter a premise. Furthermore, behavioural biometrics is used to track the concentration level of each individual either in an office or in a classroom. The recreation domain also embraced biometric technology, as can be seen in Universal Studio Hollywood, which required guests to fingerprint to enter the theme park [22].

2. LITERATURE REVIEW

The present-day attendance system is manual. It wastes a considerable amount of time both for teachers and students. The waiting time of the students is increased if attendance is taken manually. There are still chances for proxies in the class when attendance is taken manually. Manual attendance always a have a cost of human error. Recent advancements disclosed that attendance can be taken directly using several embedded system applications like RFID, Biometric fingerprint, and Iris recognition-based methods. These methods generally take more time for calculation. In [23], author presented RFID-based attendance system. RFID uses electromagnetic fields to automatically identify and track tags attached to persons. RFID can violate the privacy and security of human beings. RFID strategies ultimately effect software that allows each person to be analysed by the primary database. This environment can be easily affected by hackers. If RFID reader and receiver are not properly matched, then less read rate occurs. Biometric fingerprint identification systems employ fingerprint as a unique identity [24]. It is one of the most accurate systems running effectively today. But recognition of an individual fingerprint from a set of enrolled fingerprints is a difficult process. The fingerprint system does not reveal any information regarding the original fingerprint. This may have been proved to be false as many algorithms [25] reveal that a fingerprint can be reconstructed with minute templates. Iris Recognition [26] is another type of implementation where the iris of people is scanned, stored, and then retrieved for the comparison and attendance is managed automatically in the server. But there is difficulty in capturing iris of the students or employees and hence a fast implementation of face recognition [27] with decreased illumination effect can be used. Face is the essential recognizable proof for any human. So, automating the attendance process will increase the productivity of the class. To make it available for every platform we have chosen the Raspberry pi for face recognition. A Webcam is associated with the Raspberry Pi module. Face identification separates faces from non-faces and those countenances that can be perceived. This module can be utilized for different applications where face acknowledgment can be utilized for validation. In this proposed system we take the attendance using face recognition which recognizes the face of each student during the class hours.

3. PROPOSED SYSTEM

The current systems that are used for updating attendance automatically are usually RFID based, Bio-metric based, and MATLAB based. Usually, the manual method of taking attendance is difficult and a time-consuming process. Hence it is important to construct an efficient method for managing attendance automatically. Another advantage of these types is that inclusion of fake attendance can be prevented. Open Command Visualization

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(Open-CV) is an open source library in which the source code is open, and it is useful in visual field such as image processing. The main motto of this work is to take and manage attendance using face recognition.

This proposed attendance system is based on Raspberry Pi and a camera, which are connected to LCD monitor i.e.., digital computer or laptop. By facing the camera, the camera will capture the student image and pass it to the Raspberry Pi which is programmed to handle the face recognition by means OpenCV library. If the student's input image matches with the trained dataset image then he needs to press the attendance switch to mark his presence, then the attendance results will be stored in database.

Advantages

- This recognition system can be used for security purposes in organizations and in secured zones.
- It stores the faces that are detected and automatically marks attendance.
- This system is convenient and secure for the users.
- It saves the time and efforts of current scenario.

Applications

- Education sectors.
- Industries and IT sectors.
- Research centers where there is an access for authorized peoples only.

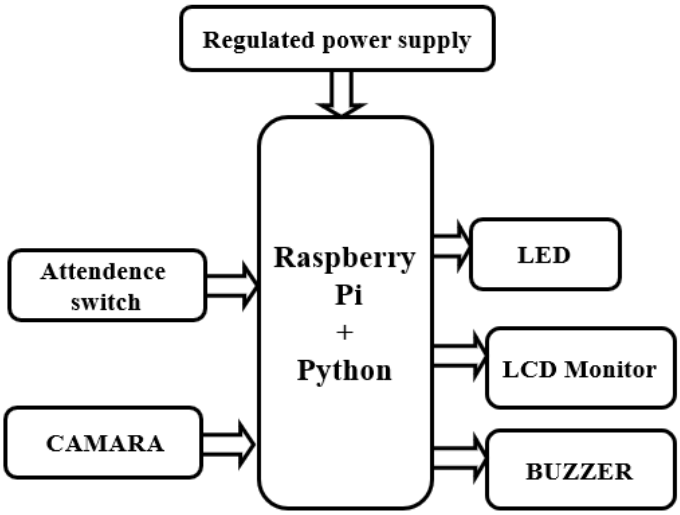

Figure 1. Block diagram of proposed face recognition-based attendance system

4. EXPERIMENTAL SETUP

Cloud storage is a data storage model where the data storage will be in logical pools. The physical storage pairs several hosts (probably numerous areas) and this environment is normally copped to and maintained by a hosting organization. These cloud renders are creditworthy for maintaining this data feasible and approachable with security. Practically, users or any companies will purchase or lease the capacity of storage from the renders for storing company, user, or any application data. Python is an interpreted, object oriented, high level programming language with dynamic semantics. Python's simple. easy to learn syntax emphasizes readability and therefore reduces the cost of program maintenance. Python supports module and packages, which encourages program modularity and code reuse.

4.1. Raspberry Pi

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It is an ultra-cheap minicomputer with 5.5 cm width and 9 cm length. It consists of a component named System on Chip (SoC) which comprises of single core CPU with a supportive processor for computing floating points, GPU and RAM with 512 MB size (SD-RAM). Moreover, it consumes less power, which is just around 5-7 watts. The architecture of raspberry pi is given in figure 2. It has couple of cache memory levels, where first level is of 32KB size and the latter is of 128KB size. These are utilized to store recent programs and ALU is utilized to execute instructions.

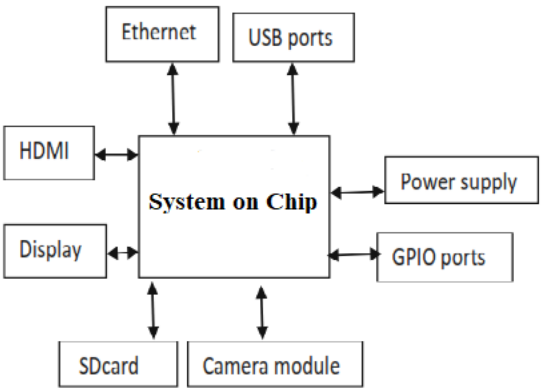

Figure 2. System architecture of raspberry pi

Table 1. Specifications of Raspberry pi

Chip	Broadcom BCM2835 SoC
Core architecture	ARM 11
CPU	700 MHz Low power ARM1176JZFS
RAM	512 MB (SD-RAM)
OS	Linux
Dimensions	$85.6 \times 53.98 \times 17\ mm$
Power	Micro USB socket, 5 V, 1.2 A

It is an exceedingly small device and can incorporate other devices also. It consists of both the hardware and software. It requires an SD card and a power supply to related mouse and keyboard. Additionally, a display also exists for functioning OS such as Windows and Linux.

Figure 3. Raspberry pi

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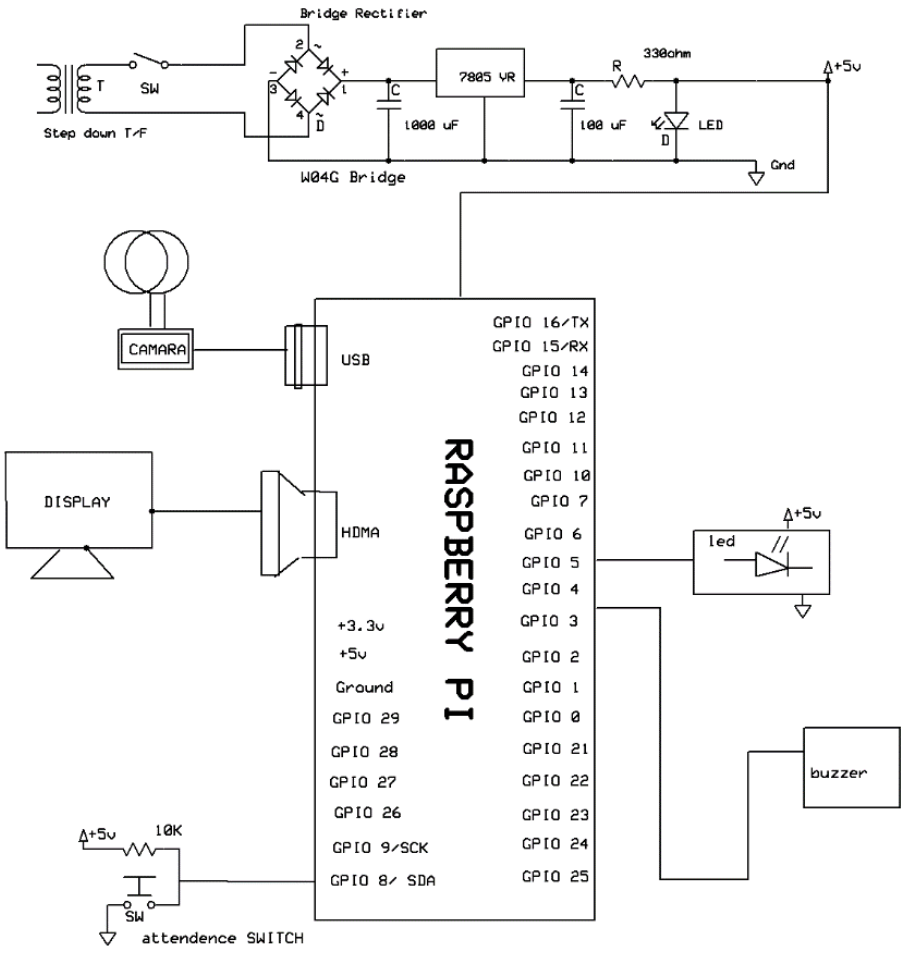

Figure 4. Proposed face recognition-based attendance system schematic diagram.

4.2. LCD

LCD is liquid crystal display technology works by blocking light. Specifically, it is made of two pieces of polarized glass that contain a liquid crystal material between them. A backlight creates light that passes through the first substrate. It is used for display purpose.

4.3. Buzzer

A buzzer or beeper audio signalling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers, and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

5. CONCLUSIONS

This article presented an attendance management system for education sectors using the approach of face recognition technology. This system utilized a Raspberry Pi installed with OpenCV library and a camera module is connected for capturing the images of student. In addition, an attendance switch is provided for storing his attendance into the database, which is stored in the memory card connected to Raspberry Pi and it can be accessed anytime.

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