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Intelligent time tracking system with facial recognition Through its Arduino Uno platform

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ABSTRACT:

An effective and automatic way for monitoring attendance is the Smart Attendance System utilizing Face Recognition with Arduino Uno, which incorporates RFID technology and the Internet of Things. To provide a safe and dependable procedure, this system uses an RFID reader and RFID tags for initial authentication, and then it uses facial recognition for identification verification. A buzzer gives auditory feedback, and a 16×2 LCD shows the status of attendance. The information is sent to an Internet of Things platform, which allows for tracking and recording in real-time. This approach is perfect for schools and businesses since it increases safety, decreases the need for human intervention, and lessens the likelihood of proxy attendance.

INTRODUCTION TO EMBEDDED SYSTEMS

A computer system that is purpose-built to carry out a single or limited set of tasks, often under the restrictions of real-time computing, is known as an embedded system. As with other physical and mechanical components, it is often integrated into a whole device. A personal computer or other general-purpose computer, on the other hand, may be programmed to do a wide variety of functions. These days, many of the everyday items we use rely on embedded systems to function. Design engineers may improve the embedded system to decrease product size and cost while boosting reliability and performance since it is devoted to certain functions. Because of their mass production, certain embedded systems are able to take advantage of cost savings. From small, handheld gadgets like digital watches and MP3 players to massive, permanently installed systems like those managing nuclear power plants, traffic lights, and industrial controls are all examples of physically embedded systems. From simple systems using a single microcontroller chip to complex systems housing several modules, peripherals, and networks in a massive chassis or enclosure, complexity may range greatly. The phrase "embedded system" lacks a precise definition because the majority of systems have programmability in some form. While they share some components with embedded systems, such operating systems and microprocessors, handheld computers are not technically embedded systems as they enable the loading of multiple programs and the connection of peripherals. Computer hardware and software, either fixed in capability or programmable, particularly intended for a certain sort of application device—this is what's called an embedded system. Embedded systems may be found in a wide variety of objects, including but not limited to: vehicles, medical devices, cameras, home appliances, aircraft, vending machines, toys, and, of course, cellular phones and personal digital assistants. A programming interface is given to programmable embedded devices, and programming for embedded systems is a niche field in and of itself. Embedded Java and Windows XP Embedded are two examples of embedded-specific operating systems and language platforms. On the other hand, certain budget consumer goods include integrated application and operating system components, employ very cheap microprocessors, and have limited storage space. Instead of being loaded into RAM (random access memory), as applications on personal computers are, in this situation the program is written permanently into the system's memory.

CHARACTERISTIC OF EMBEDDED SYSTEM

- Speed (bytes/sec): Should be high speed
- Power (watts): Low power dissipation
- Size and weight: As far as possible small in size and low weight
- Accuracy (%error): Must be very accurate
- Adaptability: High adaptability and accessibility
- Reliability: Must be reliable over a long period of time

APPLICATIONS OF EMBEDDED SYSTEMS

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Here, in the Embedded World, we are living. The smooth operation of the various embedded goods that surround you is crucial to your day-to-day existence. In your living room, you have a TV, radio, and CD player; in your kitchen, you have a washing machine or microwave oven; and at your office, you have card readers, access controllers, and palm devices that let you do a lot. In addition to all of this, your automobile has a plethora of built-in controls that handle functions between the bumpers, most of which you probably don't give a second thought to.

- **Robotics:** industrial robots, machine tools, Robocop soccer robots
- **Automotive:** cars, trucks, trains
- **Aviation:** airplanes, helicopters
- Home and Building Automation
- **Aerospace:** rockets, satellites
- **Energy systems:** windmills, nuclear plants
- **Medical systems:** prostheses, revalidation machine.

MICROCONTROLLER VERSUS MICROPROCESSOR

When comparing microprocessors and microcontrollers, what are the key differences? Any general-purpose microprocessor, such an 8086, 80286, 80386, 80486, or a Pentium from Intel, or a 680X0 from Motorola, etc., is considered a microprocessor. In addition to lacking on-chip I/O ports, these microprocessors also lack random-access memory (RAM). Because of this, they are often called general-purpose microprocessors. Designing a working system around a general-purpose CPU like the 68040 or Pentium requires the addition of extra components like as RAM, ROM, I/O ports, and timers. Though these systems are more costly and cumbersome due to the inclusion of external RAM, ROM, and I/O ports, they provide the benefit of being versatile in that the designer may choose the quantity of RAM, ROM, and I/O ports required for the work at hand. Microcontrollers are an exception to this rule. On a single chip, you'll find a microprocessor, random access memory (RAM), read/write (ROM), input/output (I/O) ports, and a timer in a microcontroller. So, since the CPU, random access memory (RAM), read/write memory (ROM), input/output (I/O) ports, and timer are all integrated into a single chip, the designer is unable to include any more memory, I/O ports, or timer into the product. Because of its set quantity of on-chip ROM, RAM, and number of I/O ports, microcontrollers are perfect for many applications where space and cost are important considerations. It is not necessary to have a 486 or even an 8086 CPU for many applications; for instance, a TV remote control. Typically, these programs will need some kind of input/output function in order to read signals and toggle bits.

MICROCONTROLLERS FOR EMBEDDED SYSTEMS

The word "Embedded System" appears often in articles on microprocessors. The embedded system products heavily use microprocessors and microcontrollers. The microprocessor (or microcontroller) in an embedded system product is designed to do a single job exclusively. An embedded system is best shown by a printer since its central processing unit (CPU) is dedicated to a single function: data retrieval and printing. Take a Pentium based PC as an example. Word processors, print servers, bank teller terminals, video game consoles, network servers, and Internet terminals are just a few of the many uses for personal computers. A wide range of apps may have their software loaded and executed. Obviously, a computer's random access memory (RAM) and operating system are what allow it to execute applications and do all those other things. This robot's fire sensor sends a signal to the microcontroller the second it detects fire. One piece of application software is usually burnt into ROM in an embedded device. Many different embedded goods, such a keyboard, printer, modem, disk controller, sound card, CD-ROM drive, mouse, and so on, are either built into or attached to an x86 PC. A single-purpose microcontroller is housed inside each of these peripherals.

INTRODUCTION

To increase productivity, precision, and safety in the modern digital world, automating attendance systems is a must. A dependable and effective solution for monitoring attendance, the Smart Attendance System utilizing facial Recognition with Arduino Uno incorporates many technologies including RFID, facial recognition, the Internet of Things (IoT), and microcontrollers. An RFID reader and RFID tags are used to identify users first, and then facial recognition is used to confirm their identity, which helps to minimize the possibility of proxy attendance. A 16×2 LCD screen gives consumers immediate feedback on their attendance status, and a buzzer notifies them when they are being authenticated. Internet of Things (IoT) platforms receive the gathered data and make it possible to view attendance records remotely and monitor in real-time. Schools, universities, workplaces, and other organizations greatly benefit from this smart system since it

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simplifies attendance management, improves security, and eliminates human mistakes.

LITERATURE REVIEW

Implementing smart attendance systems with RFID, facial recognition, and Internet of Things technology has been the subject of several studies and research publications. Manual roll calls and RFID-based identification alone are two examples of traditional attendance systems that have been shown to be inefficient and susceptible to proxy attendance. In order to improve the reliability and safety of attendance tracking, scientists have suggested using biometric data like fingerprints and facial recognition. In contrast to fingerprint-based systems, which could have problems with cleanliness and wear, facial recognition technology has attracted a lot of interest since it is contactless, efficient, and dependable. To enhance identification and reduce fraudulent attendance marking, several studies have combined RFID with biometric verification. The ability to remotely monitor and save data in real-time is another benefit of Internet of Things (IoT)-based attendance systems for administrators. An automated, safe, and scalable attendance system for companies and educational institutions may be created by combining RFID, facial recognition, and the Internet of Things with Arduino microcontrollers.

EXISTING SYSTEM

Roll calls, paper records, or radio frequency identification (RFID) authentication are some of the manual processes used by traditional attendance systems. Proximity attendance, in which people exchange RFID cards to fraudulently register attendance, remains a potential security risk with RFID-based systems, despite the fact that these systems enhance efficiency via the ability to scan cards quickly. Manual data input also makes record keeping more inefficient and prone to mistakes. While fingerprint scanners and other biometric systems provide superior protection, they may be a pain to maintain since they become dirty and worn out. Due to these shortcomings, a state-of-the-art attendance system is required, one that combines facial recognition with the internet of things (IoT) for continuous tracking that guarantees precision, safety, and automation.

PROPOSED SYSTEM

The suggested smart attendance system automates and strengthens security by combining facial recognition with an RFID identification system that uses Arduino Uno. The first step in primary authentication is scanning an RFID tag allocated to a person using an RFID reader. The next step in preventing proxy attendance is for a camera module to take a picture of the user's face and then use a facial recognition algorithm to confirm it. The status of attendance is shown on a 16×2 LCD, and a buzzer gives instant audible response. The information about attendance is then sent to an internet of things platform so that it may be tracked and recorded in real-time. This technology is perfect for schools and businesses since it gets rid of human mistake, cuts down on proxy attendance, and boosts accuracy.

BLOCK DIAGRAM

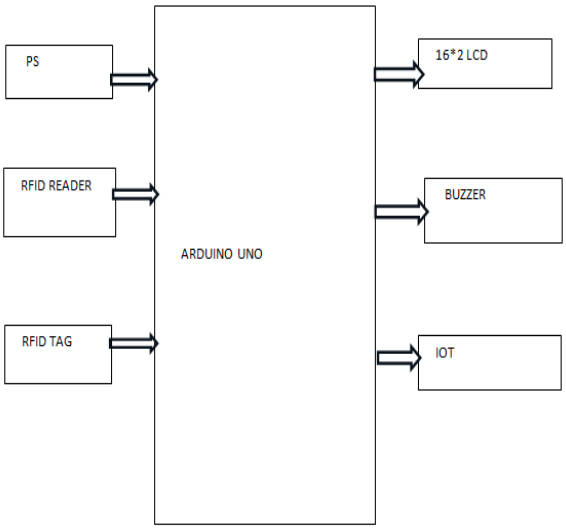

Figure 1 :Block Diagram

Microcontroller:

A tiny controller, or microcontroller, as the name implies. Often used as a processing or controlling unit, they are similar to single-chip computers. For instance, microcontrollers that do decoding and other regulating operations are likely integrated into the control you are using. They find further use in vehicles, home appliances, microwaves, toys, and any other area requiring automation.

Arduino Uno Microcontroller:

One such microcontroller board is the Arduino Uno, which uses the Atmega328 (datasheet). It has a 16 MHz crystal oscillator, 6 analogue inputs, 14 digital input/output pins (6 of which may be used as PWM outputs), a power connector, an ICSP header, a reset button, and a USB connection. All you need is a USB cable, an AC-to-DC converter, or a battery to get it going; it comes with everything you need to support the microcontroller.

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A key difference between the Uno and all previous boards is the absence of the FTDI USB-to-serial driver chip. Rather of that, it has an Atmega8U2 that has been configured to convert USB to serial. To celebrate the impending release of Arduino 1.0, the name "Uno"—which means "One" in Italian—has been chosen. The Uno and Arduino version 1.0 will serve as the foundational versions for future Arduino releases. For a comparison with prior generations, see the index of Arduino boards. The Uno is the newest in a series of USB Arduino boards and the standard model for the Arduino platform.

The USB port or an external power source are both viable options for powering the Arduino Uno. It chooses the power source mechanically. You may use a battery or an AC-to-DC converter (wall-wart) to power it from the outside (not via USB). Simply insert the 2.1mm center-positive connector into the board's power port to connect the adapter. The POWER connector's Gnd and Vin pin headers are suitable for inserting battery leads. Any voltage between 6 and 20 volts may power the board. But if the voltage is lower than 7V, the 5V pin could not give 5V and the board might become unstable. The voltage regulator might become too hot and ruin the board if you use more than 12V. A voltage range of 7 to 12 volts is ideal. Here are the pins that provide power:

• Vin. This is the voltage that the Arduino board takes in when it's not plugged into a regulated power source like a USB port. Either use this pin to deliver electricity or use it to obtain voltage from the power jack.

5.0 volts. The microcontroller and other board components are powered by the regulated power supply. You have a few options for supplying this, including the on-board regulator from VIN, USB, or another regulated 5V source.

3 and a half volts. A power source of 3.3 volts produced by the built-in regulator. No more than 50 mA may be drawn at once.

GND is required. Pinned down.

ARDUINO UNO BOARD:

One board that uses the Atmega328 microprocessor is the Arduino Uno. A 16 MHz ceramic resonator, 6 analog inputs, 14 digital I/O pins (including 6 PWM outputs), 1 USB port, 1 power connector, 1 ICSP header, and 1 reset button are all part of it. All you need is a USB cable, an AC-to-DC converter, or a battery to get it going; it comes with everything you need to support the microcontroller.

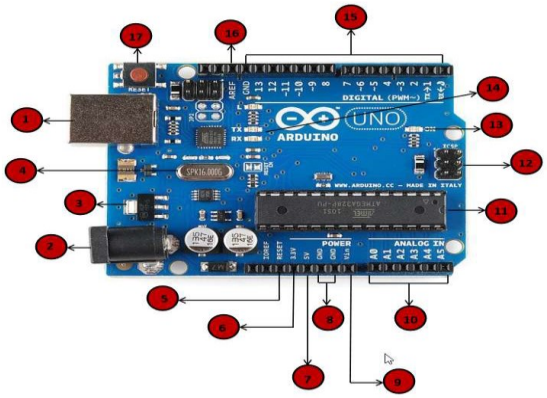

Figure 2: Arduino uno board

In contrast to all of its predecessors, the Uno does not have the FTDI USB-to-serial driver chip. As an alternative, it makes use of USB-to-serial converters coded into the Atmega16U2 (Atmega8U2 up to version R2).

HARDWARE COMPONENTS

POWER SUPPLY UNIT

The power supply for this system is shown below.

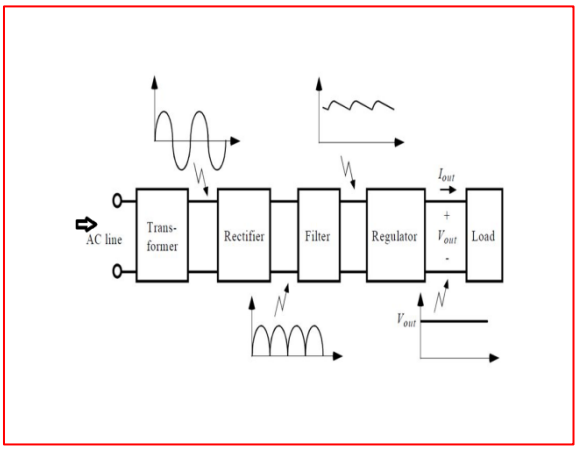

Figure 3 :Power supply

Diodes:

Only one path of electrical current may pass through a diode. Current may flow in either direction, as shown by the arrow in the circuit symbol. Originally termed valves, diodes are essentially an electrically enhanced version of the mechanical component.

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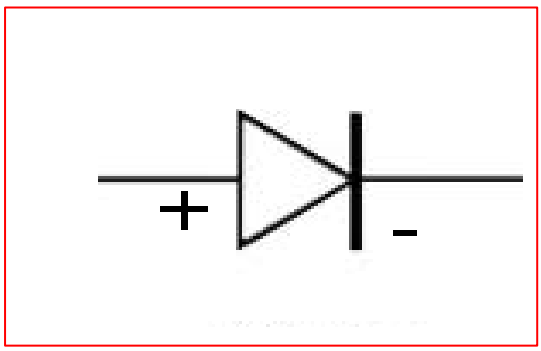

Figure 4: Diode Symbol

One kind of electrical component that restricts current flow is the diode. A voltage loss of around 0.7V will be the sole influence on the signal when the diode is "forward-biased" in this way. No current will flow through a diode that is "reverse-biased" when the current is applied in the other direction.

Rectifier

A rectifier's job is to change the phase of an alternating current (AC) waveform so that it appears as a direct current (DC) waveform. Both "half-wave" and "full-wave" rectifiers are used for rectification. Diodes are used in both devices to convert AC current into DC current. The Half-Wave Resettable The graphic shows that the half-wave rectifier is the simplest rectifier type since it only employs one diode.

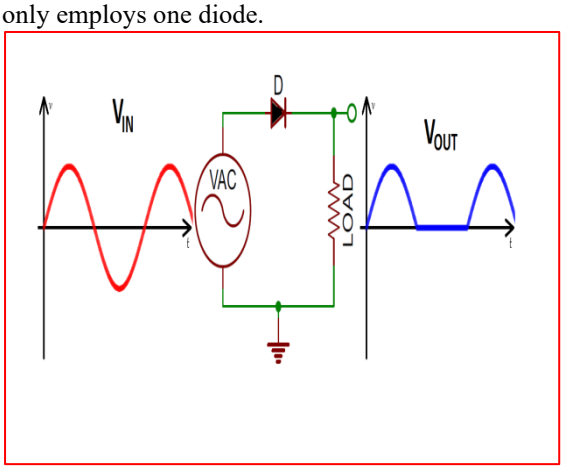

Figure 5: Half Wave Rectifier

LIQUID CRYSTAL DISPLAY

An array of color or monochrome pixels arranged in front of a light source or reflector makes up a liquid crystal display (LCD), a thin, flat display device. Two polarizing filters, with their polarity axes perpendicular to one other, and a column of liquid crystal molecules hanging between two transparent electrodes make up each pixel. Light would not be able to travel through them if the liquid crystals weren't interposed. To make light flow through two filters, the liquid crystal changes the polarization of the light entering the first filter. A program's ability to communicate with the outside world depends on its input and output devices, which in turn rely on human communication. An LCD display is a typical accessory for controllers. 16X1, 16x2, and 20x2 LCDs are among the most popular types of displays that are often linked to the controllers. Which works out to sixteen characters on a single line. The first set has 16 characters on each line while the second set has 20 characters on each line. The use of "smart LCD" displays allows for the visual output of information by many microcontroller devices. Affordable, user-friendly, and capable of producing a readout utilizing the display's 5X7 dots plus cursor, LCD displays built on the LCD NT-C1611 module are a great choice. They use mathematical symbols and the usual ASCII set of characters. The display needs a +5V power and 10 I/O lines (RS, RW, D7, D6, D5, D4, D3, D2, D1, D0) for an 8-bit data bus. The only additional lines needed for a 4-bit data bus are the supply lines and six more (RS, RW, D7, D6, D5, D4). The data lines are tri-state and do not affect the microcontroller's function when the LCD display is disabled.

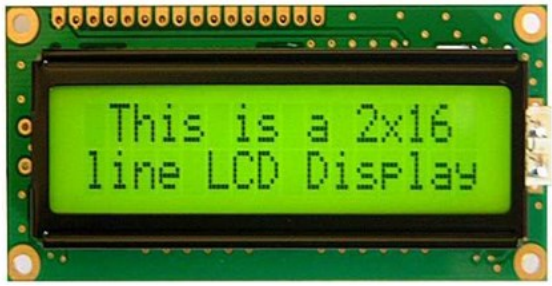

Figure 6: 2x16 LCD Display

ESP8266 Wi-Fi Module

project revolves on this. Because the project relies on WIFI control of appliances, the module is a crucial part of it.
One remarkable feature of this tiny board is the integrated MCU (Micro Controller Unit), which allows for the control of I/O digital pins via a simple programming language that is almost pseudo-code like. Another benefit is that the ESP8266 Arduino compatible module is a low-cost Wi-Fi chip with full TCP/IP capability. The Chinese company Es press if Systems is situated in Shanghai and makes this gadget.
In August 2014, this chip made its debut in the ESP-01 version module manufactured by the third-party company AIThinker. The MCU can establish basic TCP/IP connections and connect to WiFi networks with the help of this little module. He was His tiny size and cheap pricing (1.7–3.5$) enticed a

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lot of hackers and geeks to look into it and utilize it for all sorts of projects. Because of its enormous success, Espressif now offers a wide variety of models with varying size and technological specs. Its replacement includes ESP32.

RFID READER

Readers equipped with Radio Frequency Identification (RFID) technology can decipher the information contained in tags. It reads RFID tags' identifiers by communicating with them via radio waves. RFID readers find extensive use in tracking, inventory management, access control, and attendance systems.

The Function of RFID Readers

First, radio wave transmission: RFID readers provide energy to neighboring RFID tags by electromagnetic waves.

2. Tag Response: After being switched up, the RFID tag transmits its one-of-a-kind ID or stored data.

3. Processing Data: The reader receives the data that has been sent and uses it for purposes such as authentication or maintaining records.

Many Forms of RFID Readers

1. Fixed RFID Readers: These stay-put gadgets are utilized in restricted zones or at security checkpoints.

2. RFID readers for handheld devices: travel-friendly scanners for RFID tags.

3. RFID Readers Built Into Other Systems: These readers may be found in systems like security gates or attendance devices.

Standard RFID Reader for Arduino

One popular and inexpensive module that can read 13.56 MHz RFID tags is the RC522 RFID Reader, which is compatible with Arduino.

Another popular RFID module that supports SPI and I2C communication is the MFRC522 Module.

How RFID Readers Are Used

• Smart attendance systems (for use in classrooms, offices, and other public gathering places) • Entry control (for use in secured areas and buildings) • Asset tracking (for use in logistics, supply chain, and warehouses)

• Systems that eliminate the need for cash (transportation, vending machines)

RFID TAG

Tiny electronic devices called rfid tags are used for identifying and tracking reasons. An antenna and a microchip are the two main components of an RFID tag, which allows it to exchange data wirelessly with a reader. These tags may be categorized as passive, active, or semi-passive according on their power source. Typically seen in attendance systems, passive rfid tags get their power from the rfid reader's signal. On the other hand, active tags can communicate over greater distances thanks to their own battery. Depending on the situation, radio frequency identification tags may work in low-frequency (lf), high-frequency (hf), or ultra-high-frequency (uhf) ranges. To eliminate manual procedures and minimize the possibility of proxy attendance, smart attendance systems use radio frequency identification (RFID) tags issued to people and scanned by an RFID reader to authenticate and record attendance. These tags' efficiency, security, and automation make them ideal for use in cashless payment systems, vehicle monitoring, inventory management, and access control.

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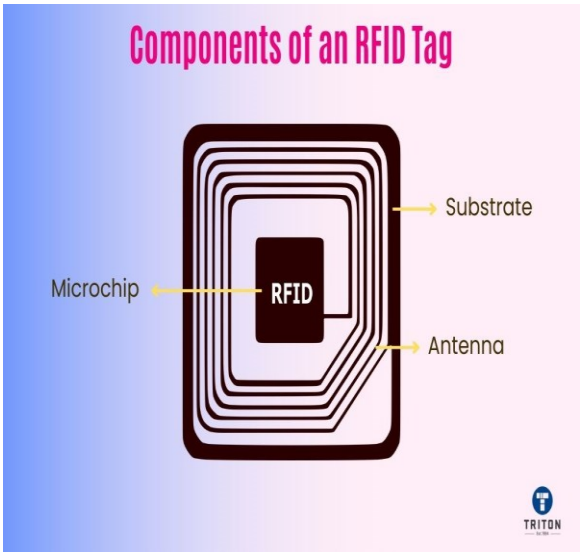
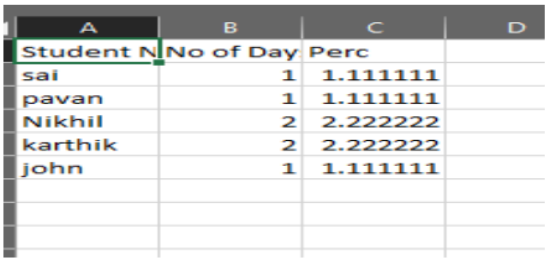


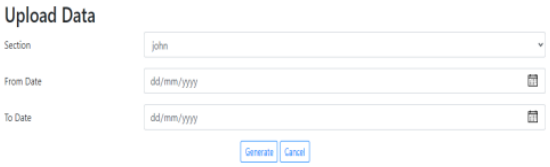
SOFTWARES

The Arduino platform is an open-source, user-friendly hardware and software environment for prototyping. It is comprised of a programmable circuit board (also called a microcontroller) and an Integrated Development Environment (IDE) called Arduino that is pre-made for writing and uploading code to the physical board. The main characteristics are: • Many sensors can send signals in digital or analog formats to Arduino boards, which may then be used to activate motors, control LEDs, establish connections to the cloud, and much more. • The Arduino IDE (also called "uploading software") allows you to command your board's operations by communicating with the microcontroller on the board. • A separate device, known as a programmer, is not required to load fresh code into an Arduino board, in contrast to most prior programmable circuit boards. The usage of a USB connection is all that is required. • The Arduino IDE employs a streamlined version of C++, which facilitates programming learning. Last but not least, Arduino offers a standardized form factor that simplifies the microcontroller's tasks. Now that we know what the Arduino UNO board is and how it works, we can go on to setting up the Arduino IDE. As soon as we figure this out, we can upload our software to the Arduino board.

RESULTS



A	B	C	D
Student N	No of Day	Perc	
sai	1	1.111111	
pavan	1	1.111111	
Nikhil	2	2.222222	
karthik	2	2.222222	
john	1	1.111111	



CONCLUSION

A trustworthy, automatic, and safe way to keep track of attendance is the Smart Attendance System that uses Face Recognition with Arduino Uno. The solution efficiently and accurately avoids proxy attendance by combining RFID identification with facial recognition. The Internet of Things (IoT) allows for record-keeping and real-time monitoring, which in turn reduces administrative burden and physical labor. The LCD and buzzer further improve user involvement by giving immediate feedback. By enhancing overall attendance management and providing security and comfort, this system provides a cost-effective and scalable solution for educational institutions and enterprises.

REFERENCES

"Attendance System Using Face Recognition Using Arduino"
This paper presents a smart attendance counting system based on IoT and IR sensors, designed to count individuals in environments like classrooms and workplaces. The system integrates an ESP32 camera module, RFID reader, tags, LCD, buzzer, IoT, and an Arduino controller. Upon scanning an RFID card, the system captures the individual's image and sends the information to the department's email. Invalid ID card scans trigger an automatic buzzer alert, enhancing security in attendance monitoring.

"RFID and Face Recognition Based Attendance System"
This paper proposes an automated attendance system that combines RFID technology with face recognition to alleviate manual data recording and eliminate fraudulent practices. The system detects authorized students as they enter and exit classrooms, maintaining authentic records and reducing traditional manual tasks. It integrates face recognition with RFID, uploading data to the cloud

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to address limitations in existing manual attendance systems.

- **"Face Recognition Based Smart Attendance System Using IoT"**

The objective of this project is to implement a face recognition attendance system for students using IoT. The proposed system addresses attendance management challenges when face images are taken under different conditions. By recognizing individuals' faces and verifying them via RFID, the system increases security and accuracy in attendance management through secure authentication.

- **"IoT Based Smart Attendance System Using RFID"**

This paper discusses an IoT-based attendance system utilizing RFID technology to automate attendance tracking. The system addresses issues associated with manual processes, such as time consumption and the potential for fraud, by automatically registering students' attendance when they present their RFID cards to the reader. This approach ensures accuracy, reliability, and time efficiency in attendance monitoring.

- **"Smart Attendance Monitoring System Using IoT and RFID"**

This research explores the design of a smart attendance monitoring system that integrates IoT and RFID technologies. The system uniquely identifies each individual based on their RFID tag attached to their ID card, streamlining the attendance process and ensuring accurate record-keeping.