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Smart Surveillance in Real Time Using Arduino

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ABSTRACT –

This paper focuses on intelligent visual surveillance systems, utilizing real-time and manual surveillance for security monitoring and daily life applications. The system uses wi-fi, a local area network, and sensors attached to security cameras to provide notifications and reduce computer burden. The ESP32 camera module captures images and streams video, while the Arduino board provides processing power and interface for sensor integration and control. This versatile and cost-effective surveillance solution is suitable for various applications.

Key Words*: *Surveillance cameras, Arduino, ESP32 Camera, Face detection

1.INTRODUCTION

In the digital age, where security and monitoring have become more crucial, real-time smart surveillance systems offer an effective means of keeping environments safe and secure. Because of its ease of use and versatility, Arduino is an open-source hardware platform that has become well-known for developing surveillance systems. This paper includes an overview of the real-time smart surveillance system that may be developed with Arduino. Arduino is an open-source electronics platform composed of hardware and software components. Its microcontroller board and integrated development environment (IDE) allow users to write, upload, and execute code to interact with the outside world and control electronic devices. Camera Module: A camera module designed to monitor the surveillance area and capture images or recordings. A WIFI module enables data transmission and wireless connections. In the modern world, being in attendance is a challenging but important obligation. Every company has a distinct system in place for keeping track of attendance—be it a register, paper and pen, or biometric devices like fingerprint and RFID scanners. Students utilizing these laborious procedures are placed on a waiting list. Every system has two processes that it must follow: verification and enrollment. The unique qualities of an individual are added to the database during the one-time enrollment procedure. During verification, the input features are compared to versions recorded in databases. The face, iris, palm, gait, or eye can all exhibit these traits. RFID-based attendance systems require their users to carry RFID tags. After scanning the tag, the user must place cards on a reader to show their attendance. Real-time video feeds captured by the ESP32 camera are wirelessly transmitted to a central processing unit. Onboard image processing algorithms analyze the video feed in real-time to identify and categorize objects inside the monitoring area. The system can distinguish between known objects and potential security threats since it recognizes objects using machine learning models.

1.1 EXISTING METHOD:

In the modern world, being in attendance is a challenging but important obligation. Every company has a distinct system in place for keeping track of attendance—be it a register, paper and pen, or biometric devices like fingerprint and RFID scanners. Students utilizing these laborious procedures are placed on a waiting list. Every system has two processes that it must follow: verification and enrollment. The unique qualities of an individual are added to the database during the one-time enrollment procedure. During verification, the input features are compared to versions recorded in databases. The face, iris, palm, gait, or eye can all exhibit these traits. RFID-based attendance systems require their users to carry RFID tags. After scanning the tag, the user must place cards on a reader to show their attendance. This could result in a fraud problem because anybody can enter and record attendance using an authorized RFID. This system also requires a lot of time. Manipulation is easy in applications such as RFID and biometrics.

2. PROPOSED METHOD:

We propose the implementation of a face detection-based attendance mechanism within our prototype system, leveraging the capabilities of an ESP32 camera. This lightweight controller boasts facial recognition functionalities and can store up to five faces. Upon powering on the camera, users will be prompted to enroll their faces for attendance tracking. To ensure data integrity, enrolled faces will be securely stored in SRAM, minimizing the risk of

data loss during power outages. Upon successful face detection, the system will transmit attendance information to a cloud IoT server, facilitating seamless record-keeping and analysis. This solution offers a simple yet efficient means of automating attendance management, enhancing efficiency and accuracy in various settings.

2.1. WORKING PRINCIPLE:

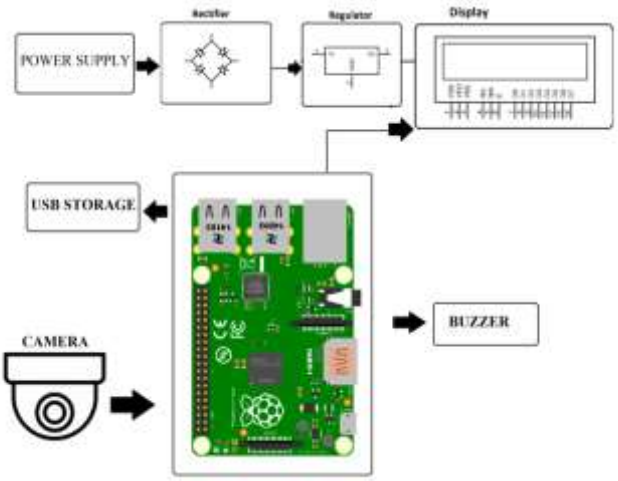

Fig1:Block diagram of Proposed Method

2.2. FACE DETECTION:

The ESP32 camera system, which has facial recognition built in, must first be initialized in order to use the face detection-based attendance mechanism. The device asks users to register their faces for attendance tracking as soon as it turns on. In order to recognize faces, this procedure entails taking pictures of faces with a camera and extracting facial traits. Enrolled faces are safely stored in SRAM by the system, protecting data integrity and lowering the possibility of data loss in the case of power failures. The system uses a pre-trained facial recognition model to continuously scan the video feed in order to identify and detect enrolled faces. Attendance data is sent to a cloud IoT server using the proper communication protocols after face detection is completed. This makes record-keeping and analysis easier and allows for effective attendance management in a variety of scenarios. Overall, this system provides a simple but efficient approach to automate attendance tracking, increasing efficiency and accuracy in attendance management procedures.eye and the cheek region.

2.3. ESP 32 CAMERA MODULE:

The tiny, low-cost ESP32-CAM development board has an integrated camera. It is the perfect answer for DIY projects, prototype construction, and Internet of Things applications.

With two powerful 32-bit LX6 cpus, the board combines Wi-Fi, conventional Bluetooth, and low-power BLE. Its primary frequency adjustment extends from 80mhz to 240mhz, and it uses a 7-stage pipeline architecture along with on-chip, Hall, and temperature sensors, among other sensors. It is fully compatible with Bluetooth 4.2 and Wi-Fi 802.11b/g/n/e/i standards. It may be used as a slave to other host mcus to enable networking on already-existing devices, or as a master mode to create an independent network controller. There are numerous iot applications that can make use of ESP32-CAM. This technology is appropriate for several Internet of Things applications, including wireless positioning system

signals, industrial wireless control, wireless monitoring, QR wireless identification, and smart home gadgets. It's a great option for Internet of Things apps.

The development board known as ESP32-CAM is built around the ESP32-S chip and incorporates a camera module, Bluetooth, and Wi-Fi networks. Suitable for a wide range of iot (Internet of Things) and DIY applications requiring camera capability, this board is adaptable.

3.IMPLEMENTATION:

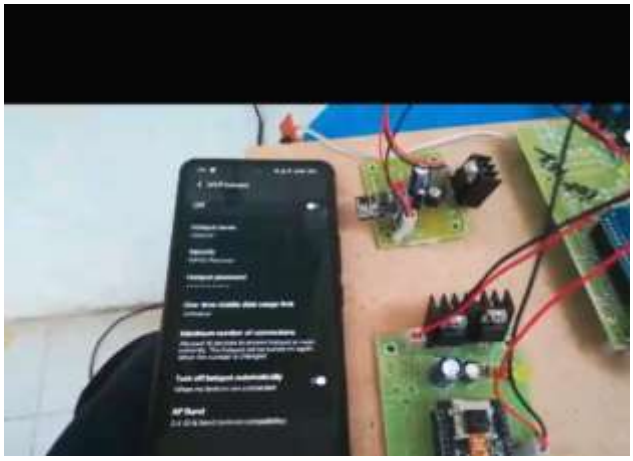

Fig2:installing app on phone and set the instructions

Fig3:enrolling sample image

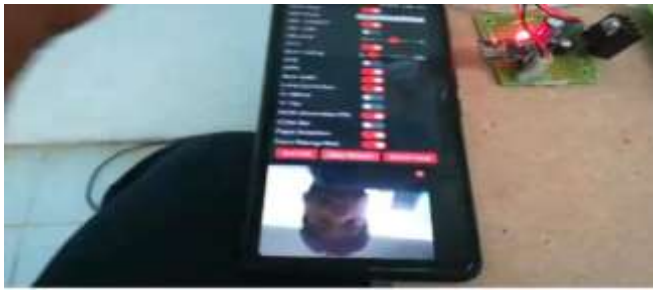

Fig4:faces enrolling on phone

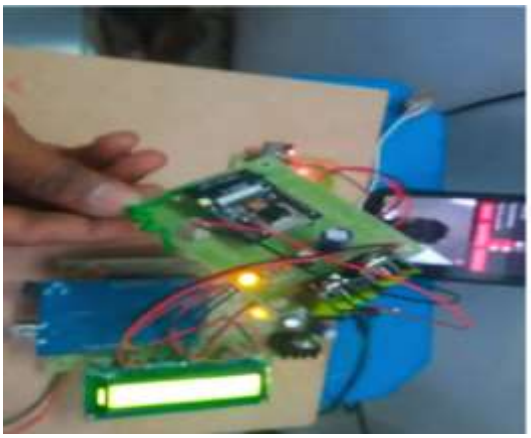

Fig5:face detecting using app

3.1. ADVANTAGES:

Using Arduino for real-time surveillance has many benefits, which makes it a popular option for professionals, hobbyists, and do-it-yourselfers. The following are some of the main benefits of utilizing Arduino for real-time surveillance implementation:

1. ***Cost-effective Solution:*** *Compared to professional surveillance systems, Arduino boards and components are comparatively inexpensive, making them an economical solution for small enterprises and individuals. Flexibility and*
2. ***Customization:*** *Since Arduino is an open-source platform, users can modify and adapt the surveillance system to suit their unique needs and tastes. When more sensors and modules are needed, users may simply integrate them, add new features, and change the code.*
3. ***Effortlessness:*** *Beginners can easily learn to program and construct their own surveillance systems thanks to Arduino's user-friendly IDE (Integrated Development Environment) and large online community. Users of all skill levels can find support and step-by-step instructions in the form of tutorials, guidelines, and example projects easily accessible.*
4. ***Flexible:*** *A vast variety of sensors, modules, and peripherals are supported by Arduino boards, making it possible to integrate a variety of parts like wifi modules, cameras, motion sensors, and more. Because of its adaptability, users can design intricate and advanced monitoring systems that are suited to their particular requirements.*
5. ***Monitoring in Real-Time:*** *Users may remotely keep an eye on the surveillance area and act fast to stop any suspicious activity or incursions thanks to the capability to record and send live video or photos in real-time. Minimal power consumption is a feature of Arduino boards, which are made to be energy efficient. Longer battery life is guaranteed, and the monitoring system's overall energy expenses are decreased.*
6. ***Scalability:*** *More sensors, cameras, or modules can be added to Arduino-based surveillance systems to cover more ground or increase the system's functionality. This allows for easy scaling or expansion.*

With no need for large changes or expenditures, users can begin with a simple configuration and then progressively extend and improve the system as needed.

7. ***Support from the Community:*** *There is a sizable and vibrant online community of Arduino developers, enthusiasts, and specialists who exchange information, provide assistance, and work together to create new libraries, tools, and resources.*

3.2. APPLICATIONS:

- ***Office and Business Security:*** *Monitoring the entrances, restricted areas, and office spaces to make sure workers are safe and to stop illegal entry. Cash registers, merchandise, and other valuables are watched over to stop loss or theft. Agriculture and*
- ***smart farms:*** *keeping an eye on cattle, crops, and agricultural machinery to spot problems or potential dangers like pests, diseases, or thievery. Automated environmental management and watering using data collected in real time from sensors.*
- ***Public Areas and Parks:*** *To guarantee the safety and security of guests, public areas, parks, and recreational spaces are monitored. Traffic flow, parking lots, and public spaces are all monitored to control crowds and improve public safety.*
- ***Traffic Management:*** *To enhance traffic safety and management, traffic flow, intersections, and road conditions are monitored.*
- ***Manufacturing & Industrial****: Surveillance of equipment, industrial lines, and manufacturing facilities to guarantee efficient operations and avert mishaps. Surveillance of surroundings or dangerous places to guarantee worker safety and adherence to safety rules.*
- ***Monitoring the Environment:*** *Keeping an eye on the pollution levels, environmental conditions, and air quality in urban or industrial locations. Collecting data in real time to analyze environmental trends and put environmental protection measures into action.*
- ***Wildlife & conservation:*** *tracking and keeping an eye on the fauna in conservation areas, national parks, and natural reserves. Monitoring threatened species or delicate environments to stop poaching, illicit logging, or environmental degradation.*

4. CONCLUSIONS

Security for homes and workplaces, traffic control, environmental monitoring, industrial monitoring, and even personal tracking are just a few of the many uses for Arduino-based surveillance systems. Because of its adaptability, DIY enthusiasts, hobbyists, and professionals that want to design personalized monitoring solutions frequently choose it. The use and accessibility of Arduino-based surveillance is one of its main advantages. For users of all skill levels, developing and implementing personal surveillance systems is comparatively easy because to the user-friendly IDE, large online community, and abundance of information. This accessibility democratizes surveillance technology, making it possible for small organizations and people to adopt advanced monitoring solutions without incurring large costs or requiring specialist knowledge.

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