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## SMART HOME AUTOMATION USING FACE RECOGNITION

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### ABSTRACT

This project presents a pioneering integration of facial recognition technology with Arduino Uno and ESP32-CAM, establishing a paradigm shift in smart home automation. Leveraging the synergy of IoT, machine learning, and microcontroller technologies, the ESP32-CAM employs pre-trained deep learning models to identify authorized users and potential intruders, enhancing both security and convenience. Acting as the central controller, the Arduino Uno facilitates seamless communication between devices, automating diverse aspects of the home environment. The system interacts with smart devices, such as door locks and climate control, tailoring the living experience to individual preferences. Privacy concerns are addressed through local data processing, ensuring the secure handling of user data. This innovative approach promises a future where homes intelligently adapt to occupants' needs while upholding robust security standards.

### I.INTRODUCTION

In recent years, the field of home automation has witnessed a surge in interest and innovation, with a profound impact on how we control and manage our household appliances and devices. This technological advancement has not only enhanced the convenience and comfort of our homes but has also played a crucial role in improving the quality of life for elderly and physically challenged individuals. Additionally, it has significantly contributed to labor reduction and energy efficiency by leveraging the

capabilities of cutting-edge sensor devices. However, the successful implementation of smart home automation presents formidable challenges, particularly in the domains of security and control management. To address these challenges, the adoption of biometric-based facial recognition technology has gained prominence in the field of home automation. This innovative approach empowers homeowners to exercise precise control over access to various resources, both automatically and through remote and manual means, facilitated by a cloud-based mobile application .

Our state-of-the-art smart home system incorporates the two-dimensional Discrete Wavelet Transform (DWT) in the face recognition stage, contributing to dimension reduction and the elimination of noise, thereby extracting distinctive facial features of authorized members. The DWT process entails selecting the approximation section of the second DWT transformation level from a facial image, which serves as input for subsequent Principal Component Analysis (PCA)-based face detection processing. PCA is widely acknowledged as a powerful technique for feature extraction and dimension reduction in the field of biometrics, effectively minimizing computational complexity.

In our system, a user-friendly website serves as an interface for generating operational commands for home devices, which respond to the activities of smart home residents. Moreover, member identification is facilitated through the application of the Euclidean distance measurement method, enabling the system to match a member's ID with the input facial image based on minimum distance [8]. This identification process is seamlessly integrated into the MATLAB platform, and the identified ID is subsequently transmitted to cloud services for further processing. The cloud services retrieve the member's profile, which contains

specific privileges associated with the passed ID. A cloud-based instruction is then dispatched to the microcontroller installed within the home system, activating appliances and features tailored to the member's profile. Another crucial component of our smart home system leverages the Arduino board, an open-source electronic prototyping platform, to manage incoming sensor signals [9][10]. These signals are processed and relayed to the system database, which houses the control privileges of all members. As a result, the system autonomously executes commands based on the sensor signals received by the microcontroller, responding to the activities and needs of home occupants. The system's website interface is instrumental for generating operational commands for home devices and is accessible to administrators who can remotely monitor and control home appliances and manage member privileges.

In summary, our smart home automation system, driven by the power of ESP32 and Arduino, embodies a blend of cutting-edge technology, biometric security, and cloud-based management, offering homeowners an intelligent and responsive living environment.

## II. LITERATURE REVIEW

1.A Wearable Device used for Smart Doorbell in Home Automation System, Abdul Basit; Komal

Saxena; Ajay Rana, Technology is very rapidly changing nowadays. Doorbells with a camera to check the visitor is an old way on Screen at home. This Paper talks about Smart Doorbells are used for unlocking the doors by Biometric Authentication. It introduces the idea of storing the Biometrics of the visitors in a local database and recognizes them later. When a Visitor comes and rang the bell, it captures all the essential information such as Face image, Iris image, and Voice of the visitor. It keeps the record of all the visitors that visit home. Also, it alerts about any motion outside the home and enables to interact with the visitor from anywhere. It can be controlled by Smart Ring. Smart Rings are valuable for monitoring and controlling the device from anywhere. Smart Rings are compatible with the device as they allow a quick notification to the user. The Doorbell Provides a Two-way Audio-Video communication between the User and Visitor at any place at any time.

2. Smart Home Automation with Smart Security System over the Cloud, Gaurav Verma; Sachin Pachauri; Ashish Kumar; Deepak Patel; Aman Kumar; Aman Pandey, This article outlines a comprehensive smart home automation system that utilizes ESP32 and ESP32-CAM modules, along with IoT cloud integration, to provide a seamless and secure automation experience. The system integrates various sensors, actuators, and cameras to enable remote control, monitoring, and intelligent security features for a smart home environment. The proposed system focuses on enhancing

convenience, energy efficiency, and safety for homeowners. The majority of appliances and items have become automated as a result of the rapid advancement of technology in recent years. The rise of automated systems is a result of people's preference for them over manual ones in today's society. IoT is a developing technology that enables people to quickly connect to the cloud, manage hardware by the internet, and operate equipment from a distance IoT technology is extensively employed in the construction of smart cities, smart houses, smart roads and agricultural sector. Recently, individuals have entirely changed, surrounded by technology and the internet, and they feel compelled to access the majority of things remotely by their smart phones or the internet since they are more economical and energy-efficient. Modern home are replacing traditional switches with remote control systems that may be used with smartphones. Home automation will be able to provide better security; comfort and it could be extremely helpful for elderly or handicapped people to easily operate the home appliances. This module is very simple to install and easy to use, and it regulates the household appliances. This paper is entirely based on low-cost and dependable Internet of Things-based home control monitoring system.

### **III. EXISTING SYSTEM**

The existing system for smart home automation using face recognition typically involves the integration of facial recognition technology with various home devices such as security cameras,

door locks, lighting systems, and thermostats. While this system offers convenience and security by allowing homeowners to control their devices through facial recognition, it has several disadvantages. One of the main drawbacks is the reliance on a stable internet connection for real-time recognition, which can be problematic in areas with poor connectivity or during internet outages. Additionally, existing systems may have limited accuracy in facial recognition, leading to false positives or negatives, potentially compromising security and user experience.

#### **IV. PROPOSED SYSTEM**

The proposed system aims to address the limitations of the existing system by incorporating advanced algorithms and technologies. By leveraging edge computing, the proposed system reduces dependency on the internet for facial recognition tasks, improving reliability and responsiveness. Moreover, employing machine learning techniques enhances the accuracy of facial recognition, minimizing the occurrence of false identifications. Another advantage of the proposed system is its scalability and flexibility, allowing for seamless integration with a wide range of smart home devices and customization according to user preferences. Overall, the proposed system offers enhanced reliability, accuracy, and user experience, making it a superior choice for smart home automation using face recognition.

#### **V. MODULES**

##### **Module 1: Login Screen**

The Login Screen module is the entry point of the application, serving as the user authentication interface. Users, both administrators and regular users, interact with this screen to gain access to the system. It typically includes fields for entering usernames and passwords and may incorporate additional security features like multi-factor authentication. This module is critical for ensuring that only authorized individuals can access the functionalities of the application.

##### **Module 2: Admin Module**

The Admin Module is designed for users with administrative privileges. It provides access to features and controls that are specific to system administration. Administrators can perform tasks such as managing user accounts, configuring system settings, and overseeing overall system functionality. This module often includes tools for monitoring and maintaining the health and security of the application.

##### **Module 3: User Module**

The User Module is tailored for regular users of the application. It encompasses features and functionalities that users interact with in their day-to-day use of the system. This module can include tasks such as updating personal



information, accessing application features, and customizing user-specific settings. It focuses on providing a user-friendly experience and facilitating the primary functions of the application.

#### Module 4: Back-End Module

The Back-End Module is the core of the system, responsible for managing data, processing requests, and ensuring the overall functionality of the application. It interacts with the database, processes user inputs, and communicates with other modules to facilitate a seamless user experience. This module is typically not directly visible to users but plays a crucial role in the reliability and efficiency of the entire system.

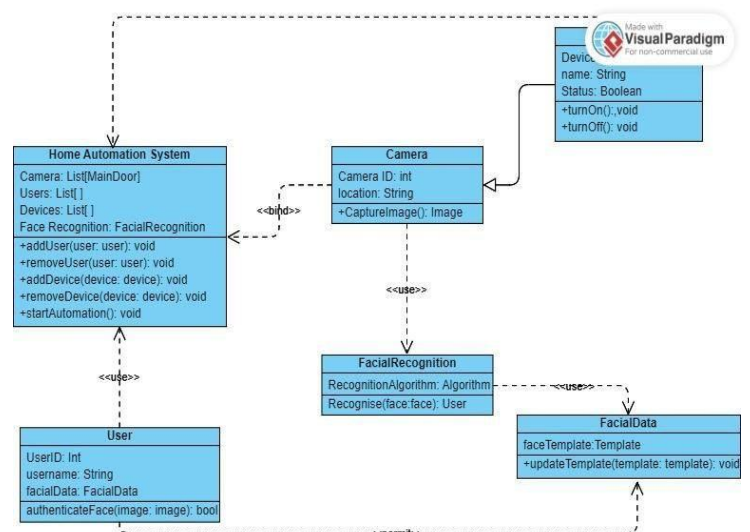
In summary, these modules collectively form a comprehensive system where the Login Screen controls access, the Admin Module manages system administration, the User Module caters to regular user interactions, and the Back-End Module powers the underlying functionality of the application. The modular structure allows for a well-organized and scalable system architecture.

#### CONCLUSION:

In conclusion, the project's modular design, comprising the Login Screen, Admin Module, User Module, and Back-End Module, represents a strategic and comprehensive approach to system development. The Login Screen establishes a secure entry point, ensuring that access is granted only to authorized users. The Admin Module empowers administrators with tools to manage the

system efficiently, configure settings, and maintain security. On the user front, the User Module enhances the overall experience by providing intuitive interfaces for regular interactions and personalization. Meanwhile, the Back-End Module serves as the backbone, seamlessly connecting and coordinating the functionalities of the entire system.

This modular architecture not only promotes a clear separation of concerns but also facilitates scalability and maintainability. Each module addresses specific aspects of the system's functionality, making it easier to extend and enhance the application over time. Furthermore, the approach emphasizes security through the Login Screen and the Admin Module, ensuring that user data is protected and system integrity is maintained. By incorporating these modules, the project achieves a balance between user accessibility and system control, catering to both administrators and regular users. This holistic design ensures a robust, user-friendly, and scalable platform that can adapt to evolving requirements. The successful integration of these modules lays the foundation for a dynamic and efficient system that aligns with the project's goals of functionality,



security, and user experience.

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