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Smart Home Security

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ABSTRACT: The abstract highlights a comprehensive smart home security system utilizing Raspberry Pi and Ubidots. It integrates face recognition for door security, LPG gas and fire detection, and remote appliance control. Emphasizing safety and convenience, future enhancements may include intrusion detection and environmental monitoring.

KEYWORDS: Security, Detection, Control, Convenience, Monitoring.

I. INTRODUCTION

In recent years, the smart home concept has evolved from a futuristic idea to a practical reality, driven by technological advancements and the growing demand for convenience, efficiency, and safety in residential settings. This project aims to advance smart home security by integrating Raspberry Pi, the Ubidots platform, and various sensors to address key aspects of home security and automation. At the core is the Raspberry Pi, serving as the central control hub. Leveraging its computing power and GPIO pins, it coordinates interactions among system components for data acquisition, processing, and communication.

Key features include door security with face recognition using the LBPH algorithm, gas and fire detection sensors, and remote appliance control via Ubidots. Alerts are sent via Telegram for timely homeowner response. This project demonstrates how technology can create a user-friendly smart home security system, providing homeowners with greater control and peace of mind. APPLICATIONS OF IOT

The applications for internet connected devices are extensive. Multiple categorizations have been suggested, most of which agree on a separation between consumer, enterprise (business), and infrastructure applications.

The ability to network embedded devices with limited CPU, memory and power resources means that IOT finds applications in nearly every field. Such systems could be in charge of collecting information in settings ranging from natural ecosystems to buildings and factories, thereby finding applications in fields of environmental sensing and urban planning.

IOT has many applications such as consumer application, smart home, enterprise, media, infrastructure management, manufacturing, agriculture, energy management, environment monitoring, building and home automation, metropolitan scale deployments.

II. RELATED WORK

1. Automatic door access using face recognition: This paper proposes bolstering door security with facial detection and recognition, employing eigenfaces via principal component analysis (pca). Recognized faces grant automatic entry, while unknown faces trigger alarms. Pca efficiently compresses image dimensions without losing key features, making it an ideal choice for door security systems.[1]
2. Gas leakage detection in iot-based smart home: This research paper focuses on gas leakage detection in iot-based smart homes. It discusses the implementation of gas sensors integrated with raspberry pi and iot platforms to monitor gas levels and trigger alerts in case of leaks, enhancing home security and safety.[2]
3. Gas-leakage detection based on iot: This paper suggests an iot-based gas leak detection and monitoring system for home security. It automatically books gas refills via wifi when the cylinder nears empty, and

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alerts users and the gas agency of leaks. Load cells monitor lpg levels, ensuring timely notifications to the agency. Iot integration streamlines gas booking, enhancing safety and convenience.[3]

4. Fire detection and monitoring systems for smart homes: This review article explores fire detection and monitoring systems designed for smart homes. It discusses the integration of fire sensors with raspberry pi and iot platforms to detect and mitigate fire hazards, highlighting the importance of real-time monitoring and alerting mechanisms.[4]
5. A review on smart home system: This paper introduces a smart home system (shs) that integrates home automation, environmental monitoring, and health monitoring. Utilizing microcontroller mikro c software and wireless internet services, it employs passive and active sensors for control and monitoring. The system achieves comfort, security, privacy, and cost-effectiveness, enhancing users' quality of life and independence.[5]
6. Integration of raspberry pi and iot for home automation, a review: This review paper examines the integration of raspberry pi with iot platforms for home automation purposes, including security applications. It discusses the role of raspberry pi in collecting sensor data and communicating with iot platforms like ubidots for remote monitoring and control.[6]

III. PROJECT DESIGN

System architecture:

The Raspberry Pi will serve as the system's central controller and will be linked to a number of other parts, such as a camera for face recognition, a gas sensor for detecting LPG, a fire sensor for detecting fires, a relay module for controlling appliances, and an integration with the Ubidots platform for remote control.

Hardware Setup:

- Raspberry Pi will be connected to the camera for face recognition, MQ6 sensor for LPG gas detection, fire sensor for fire detection, and relay module for controlling appliances.
- GPIO pins of Raspberry Pi will be used for interfacing with sensors and relay module.

Face Recognition System:

- Utilize the Local Binary Patterns Histogram (LBPH) algorithm for face recognition.
- Develop functions to capture images from the camera, preprocess them, and perform face recognition.
- Implement logic to authenticate recognized faces and control the door lock.

Gas and Fire Detection:

- Use the MQ6 sensor for LPG gas detection and a fire sensor for fire detection.
- Set thresholds for gas concentration and temperature to trigger alerts in case of gas leaks or fire incidents.
- Implement logic to send alerts via Telegram upon detection of gas leaks or fire.

Remote Appliance Control via Ubidots:

- Integrate the system with the Ubidots platform for remote monitoring and control of appliances.
- Use relay modules connected to Raspberry Pi to control appliances such as geysers and lights.
- Implement logic to send commands to Ubidots to control appliances based on user inputs or sensor data.

User Interface Design:

- Design user interfaces for remote monitoring and control of the system.
- Develop features for viewing camera feeds, receiving alerts, and controlling appliances via the user interface.

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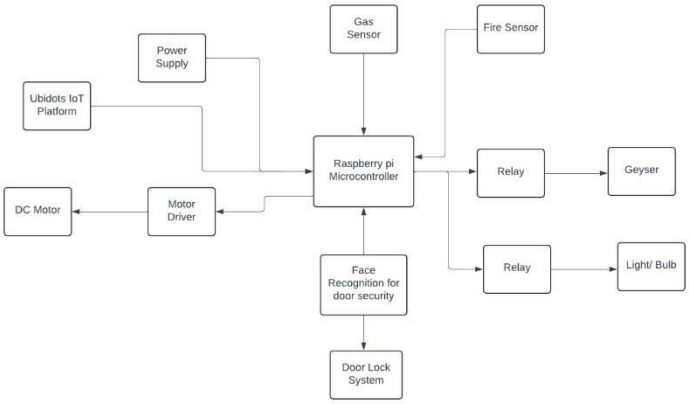

Figure 1. High level design of smart home security

IV. IMPLIMENTATION

Setting up Raspberry Pi:

- Install the Raspbian operating system on the Raspberry Pi.
- Configure network connectivity and install necessary libraries for Python programming and interfacing with sensors.

Setting up Ubidots IoT Platform:

- Create a Ubidots account. Set up a new device on the Ubidots dashboard for the smart home security system. Generate an API key for authentication between the Raspberry Pi and the Ubidots plat- form. Develop Python scripts to send sensor data to Ubidots using HTTP requests or MQTT protocol.

Face Recognition System Implementation:

- Use OpenCV library in Python to capture images from the laptop's built-in camera and perform face recognition using the LBPH algorithm.
- Develop functions to preprocess images, extract facial features, and authenticate recognized faces.
- Integrate face recognition with door security mechanism to control access.

Gas and Fire Detection Implementation:

- Connect the MQ6 sensor and fire sensor to Raspberry Pi's GPIO pins.
- Develop Python scripts to continuously monitor sensor data and detect anomalies indicative of gas leaks or fire incidents.
- Implement logic to trigger alerts via Telegram upon detection of gas leaks or fire.

Remote Appliance Control Implementation via Ubidots:

- Develop Python scripts to interface with the Ubidots API and send commands to control appliances based on user inputs or sensor data.

Integration and Communication:

- Implement logic to coordinate the interaction between different components of the system, such as face recognition, gas detection, and appliance control.
- Ensure seamless communication and data exchange between Raspberry Pi and external devices/platforms, such as the laptop camera and Ubidots platform.

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User Interface Implementation:

- Develop the user interface for remote monitoring and control of the system.
- Implement features for viewing camera feeds, receiving telegram notification alerts, and controlling appliances via the user interface.

Testing and Validation:

- Conduct thorough testing of the system to ensure proper func- tionality and reliability.
- Validate the system's effectiveness in detecting and mitigating gas leaks and fire hazards in a controlled environment.

Maintain and Monitoring:

- Maintenance involves regular checks and updates to ensure system functionality. Monitoring entails ongoing observation to detect and address issues promptly

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V. RESULTS

Results: Promising results were obtained from the smart home security project, which demonstrated useful modules for improving home safety. Face recognition was used by the door security system to provide secure entry, precisely identifying authorized users and recording unlawful attempts. Proactive danger detection was proven with LPG gas and fire detection modules, which resulted in timely alarms. The ability to integrate remote appliance control provided ease by allowing consumers to remotely manage devices. In summary, the research showcases how IoT and ML technologies can revolutionize home security and create smarter, safer living spaces.

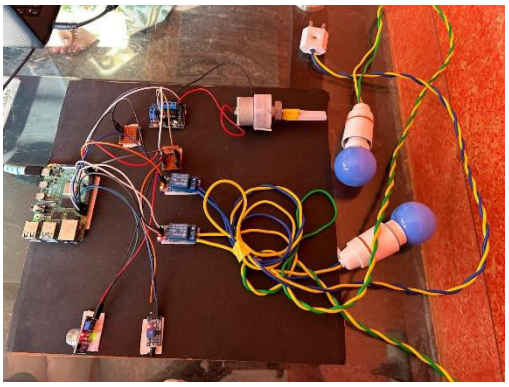

Figure 2. Connection of Smart Home Security

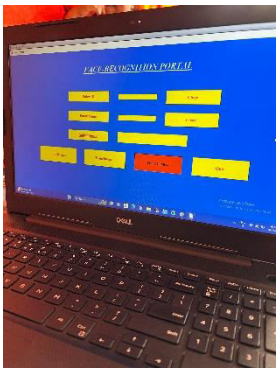

Figure 3. Face Recognition Portal

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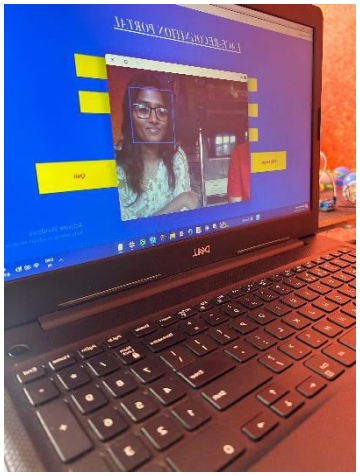

Figure 4. Face Recognition

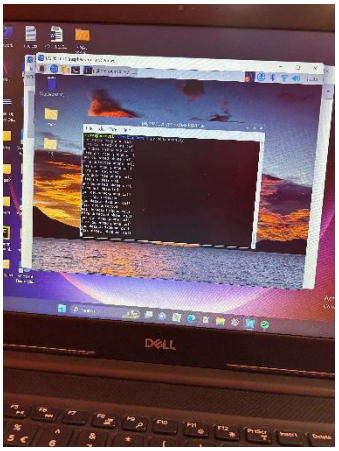

Figure 5. Output of LPG Gas Detection

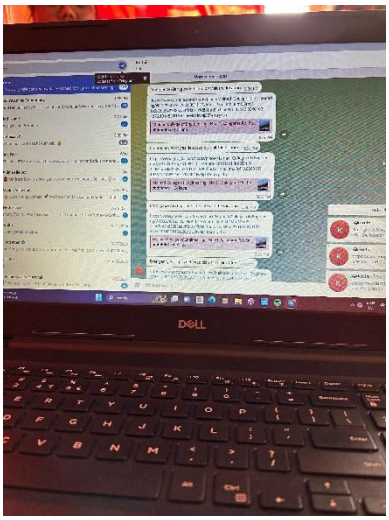

Figure 6. Telegram Alerts

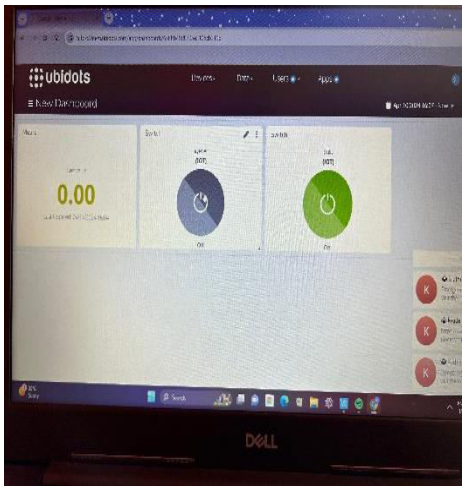

Figure 7. Control of Geyser and Light via Ubidots

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Figure 15. Output of Geysers and Light Control

VI. CONCLUSION

The smart home security project offers a holistic solution for enhancing safety and convenience in homes. It includes modules for entrance security, LPG gas detection, fire detection, and remote appliance control. Facial recognition technology ensures secure access, logging unauthorized attempts and granting entry to recognized individuals promptly. Integrated LPG gas and fire detection modules provide early threat detection, leading to timely alerts to mitigate emergencies. Remote appliance management enhances convenience and energy efficiency, allowing users to control household devices remotely. Overall, this project showcases the transformative potential of IoT and ML technologies in modernizing residential living, making homes safer, smarter, and more connected globally.

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