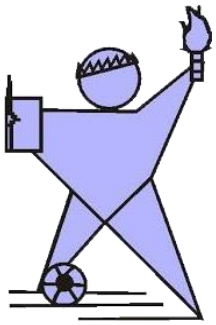

Home Security and Automation

A Report Submitted at

IPS Academy, Institute of Engineering and Science, Indore

In partial fulfillment of the degree

of

Bachelor of Technology

in

Computer Science and Engineering (IoT)

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IPS ACADEMY, INDORE INSTITUTE OF ENGINEERING & SCIENCE

(A UGC Autonomous Institute Affiliated to RGPV)

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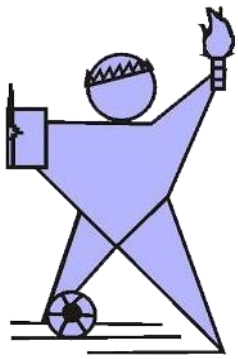
Certificate



This is to certify that **Mr. Aaditya Mahashabde (0808IO221001), Mr. Ajay Pandey (0808IO221003), Ms. Ayushi Muleva (0808IO221010), Mr. Gaurav Baraskar (0808IO221016), Ms. Khushboo Dubey (0808IO221020), Mr. Priyanshu Mandloi (0808IO221030),** studying in **Second year B.Tech. (Computer Science and Engineering (IoT))** in the year 2023-24 of this institute have satisfactorily completed the project titled "**Home Security and Automation**" as a workshop project for the award of the degree of **Bachelor of Technology in Computer Science and Engineering (IoT) at IPS Academy, IES, Indore.**

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We would like to take this opportunity to express our appreciation to our trainer and guide **Mr. SHARAD JAIN,** for his undue support and encouragement along with his superb guidance that helped us to complete our project and this report successfully. His everlasting patience and wholehearted inspiration helped us a lot in completion of our project on "**Home Security and Automation"**.

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PROBLEM STATEMENT

Forgetting to turn off lights: People often forget to turn off lights when leaving a room, leading to energy wastage.

Forgetting to lock doors: Forgetting to lock doors when leaving home can compromise home security.

Monitoring home while away: People may worry about the security of their home when they are away and wish to monitor it remotely.

Adjusting home temperature: People may want to adjust their home temperature for comfort and energy efficiency.

Monitoring air quality: Concerns about air quality indoors and wanting to monitor and improve it.

Security concerns: General security concerns about break-ins or intruders when not at home.

Emergency response: Being prepared for emergencies like fires or medical incidents when at home or away.

Managing multiple devices: Difficulty in managing and controlling various home devices like lights, appliances, and security systems.

Energy consumption awareness: Wanting to be more aware of and reduce energy consumption in the home.

Remote control: Desire for remote control and monitoring of home devices for convenience and peace of mind.

These are common problems that your IoT-based home security and automation system can help address.

We have solved some problems like fire detection, theft detection, remote light control and remote AQI monitoring.

INTRODUCTION

The IoT-Based Home Security and Automation System is a sophisticated solution designed to enhance home security and automation using flame, gas, and PIR (Passive Infrared) sensors. These sensors detect critical events such as fire, gas leaks, and motion, enabling proactive security measures and automated responses. By integrating these sensors with microcontrollers and web technologies, the system provides real-time monitoring, alerts, and remote-control capabilities through a user-friendly web interface.

- Integrated Web Interface: The system's web interface serves as a central command center, allowing users to monitor and control their home environment remotely. Through this interface, users can receive real-time alerts, view sensor data, and manage connected devices from anywhere in the world.

- Efficient Communication: Utilizing Websockets, the system ensures fast and reliable communication between sensors, microcontrollers, and the web interface. This enables quick transmission of sensor data in JSON format, facilitating rapid responses to detected events.

- User-Friendly Design: Despite its sophisticated features, the system is designed with user-friendliness in mind. The intuitive web interface, coupled with simple setup and installation processes, ensures that users can easily configure and manage the system to suit their needs.

WORKING PRINCIPLE

When an event is detected by the sensors, such as motion or a change in environmental conditions, the sensors send a signal to the microcontroller. The microcontroller processes this signal and activates a buzzer to alert individuals in the vicinity about the detected event.

Simultaneously, the microcontroller also formats the relevant data into a JSON (JavaScript Object Notation) format. This data includes information about the detected event, such as the type of event and the sensor that triggered it.

The microcontroller then establishes a connection to the website using websockets on port 81. Websockets provide a bidirectional communication channel between the microcontroller and the website, allowing for real-time data transfer. The microcontroller sends the formatted data to the website using this websocket connection.

On the website side, JavaScript code handles the incoming data from the microcontroller. This code processes the JSON data and performs actions based on the type of event detected. For example, if the event is a motion detection alert, the JavaScript code may display a notification on the website or trigger a specific response, such as sending a notification to the homeowner's smartphone.

Overall, this system allows for the detection of events by sensors, activation of alerts through a buzzer, and real-time communication of data to a website for further processing and response handling using websockets and JavaScript.

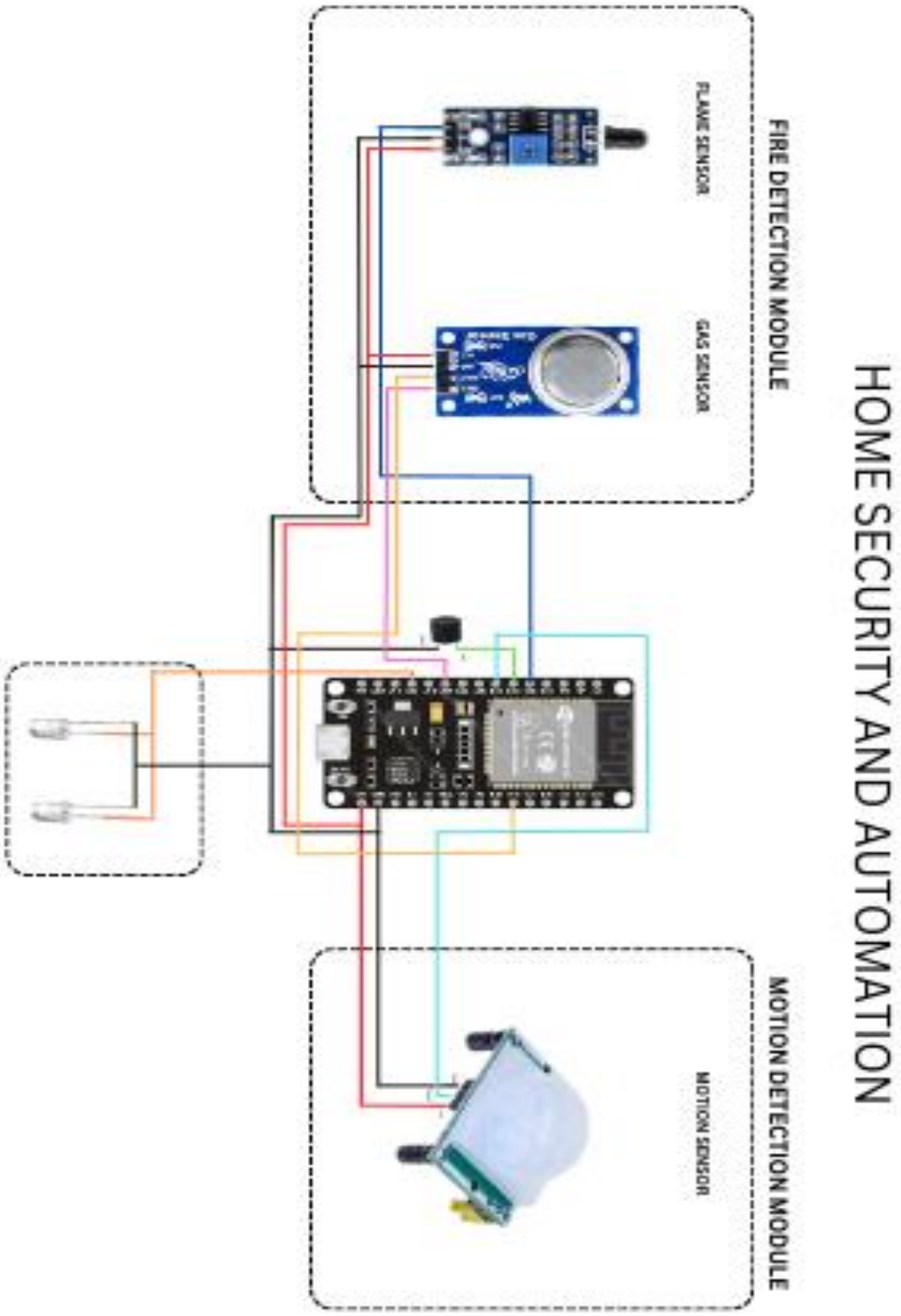
COMPONENT LIST

S.No.	Component	Description
1.	**ESP32 NODE-MCU**	• **Microcontroller:** ESP32, a powerful dual-core microcontroller with Wi-Fi and Bluetooth connectivity. • **Features:** Built-in Wi-Fi (802.11 b/g/n) and Bluetooth (Bluetooth v4.2 and BLE). • **Programming:** Can be programmed using the Arduino IDE, ESP-IDF, or other development environments. • **GPIO Pins:** Provides multiple GPIO pins for interfacing with sensors, actuators, and other electronic components. • **USB Connectivity:** Includes a micro-USB port for power and programming. • **Onboard Components:** Some versions may include onboard LEDs, buttons, and voltage regulators.
2.	**FLAME SENSOR**	• **Detection Principle:** Detects specific wavelengths of infrared light emitted by flames. • **Response Time:** Rapid detection of flames. • **Output Signal:** Generates an electrical signal when a flame is detected. • **Applications:** Used in fire detection and safety systems.

		• **Integration:** Can be integrated into larger safety systems. • **Usage Tips:** Requires proper installation and calibration for accurate detection. • **Benefits:** Fast and reliable flame detection for safety and prevention.
3.	**GAS SENSOR[MQ-2]**	• **Target Gases:** LPG, propane, methane, alcohol, smoke, and other combustible gases. • **Detection Range:** Typically detects gases in concentrations ranging from 300 to 10,000 parts per million (ppm). • **Sensor Material:** Tin dioxide (SnO2) semiconductor sensitive material. • **Response Time:** A few seconds for detecting the presence of gases.
4.	**MOTION SENSOR[HC-SR501]**	• **Detection Method:** Passive Infrared (PIR) detection. • **Detection Range:** Typically adjustable from a few meters to around 7 meters (approximately 23 feet). • **Detection Angle:** Usually covers a wide angle of around 120 degrees. • **Operating Voltage:** Typically operates at 5 volts DC.

		• **Output Signal:** Digital output (high or low) when motion is detected. • **Delay Time:** Adjustable delay time (often ranging from a few seconds to a few minutes) after motion is detected. • **Trigger Mode:** Can be set to repeatable (default) or non-repeatable trigger mode. • **Sensitivity:** Adjustable sensitivity to customize the detection range.
5.	**LED LIGHTS**	• **Light Emission:** LEDs emit light when current passes through them. • **Efficiency:** Highly energy-efficient, converting most energy into light. • **Longevity:** Last tens of thousands of hours. • **Instant Illumination:** Illuminate instantly without warm-up time. • **Compact:** Small size and available in various colours.

CIRCUIT DIAGRAM



THEORY

Working Principle of Sensors:

- **Flame Sensor:** Flame sensors work based on the principle of detecting infrared (IR) radiation emitted by flames. When a flame is present, it emits IR radiation in the 700 nm to 1000 nm wavelength range. The flame sensor detects this IR radiation and triggers an output signal indicating the presence of a flame.

- **Gas Sensor:** Gas sensors operate using various principles depending on the type of gas being detected. For example, a gas sensor for detecting combustible gases like methane or propane might use a heated filament that reacts with the gas, causing a change in resistance which is then detected and converted into an output signal.

- **ESP32 NODE-MCU**

  The ESP32 is a powerful microcontroller commonly used in IoT projects. It features dual-core processing, built-in Wi-Fi and Bluetooth, and a rich set of peripherals. It can be programmed using the Arduino IDE or ESP-IDF and is suitable for a wide range of applications, including home automation, industrial automation, and wearable devices, due to its low power consumption and versatility.

- **ESP32 Web Server:**

  The ESP32 can be programmed to act as a web server using the Arduino IDE and libraries such as the ESPAsyncWebServer library. The web server can handle HTTP requests from clients (such as a web browser or another device) and respond to them accordingly.

- To set up a web server on the ESP32, you would typically configure the server to listen on a specific port (e.g., port 80 for HTTP) and define routes for handling different types of requests (e.g., serving web pages, receiving data from sensors).

- **ESP32 WebSockets:**

  WebSockets allow for real-time, bidirectional communication between a client (such as a web browser) and a server (such as the ESP32). This is particularly useful for applications where you need to send and receive data quickly and efficiently.

  To use WebSockets on the ESP32, you can use libraries such as the ArduinoWebSockets library. This allows you to establish a WebSocket connection with a client and send and receive messages over that connection.

- **JSON Data Format:**

  JSON (JavaScript Object Notation) is a lightweight data-interchange format that is easy for humans to read and write and easy for machines to parse and generate.

  When sending data from the ESP32 to a website, you can format the data as a JSON object. For example, you might create a JSON object that contains key-value pairs representing the sensor readings (e.g., {"flame": true, "gas": false}) and send this JSON object over the WebSocket connection to the website.

- **HTML**

  HTML (Hypertext Markup Language) is used in your project to create the web interface. It provides the structure for your web pages, including elements like headings, paragraphs, images, and links. HTML forms are used to collect user input, and semantic elements improve accessibility. Overall, HTML is essential for creating a user-friendly interface for monitoring and controlling your IoT-Based Home Security and Automation System

- **CSS**

  CSS (Cascading Style Sheets) is used in your project to style the HTML elements of your web interface. It controls the visual presentation, including layout, colours, fonts, and spacing. CSS ensures your IoT-Based Home Security and Automation System has a visually appealing and user-friendly design.

- **JavaScript Handling of Data:**

  On the website side, JavaScript code can listen for incoming messages over the WebSocket connection from the ESP32. When a message is received, the JavaScript code can parse the JSON data and take appropriate actions based on the sensor readings.

  For example, if the JSON data indicates that a flame has been detected, the JavaScript code could display a notification on the website alerting the user to the presence of a fire.

FEATURES

Enhanced Home Security: The system's ability to detect and alert homeowners to potential threats such as fire, gas leaks, and intruders enhances overall home security and provides peace of mind.

Remote Monitoring and Control: The web interface allows users to monitor their home environment remotely and control devices such as lights and appliances, improving convenience and energy efficiency.

Energy Management: By automating the control of lights and appliances based on occupancy and user preferences, the system helps reduce energy consumption and lower utility bills.

Air Quality Monitoring: The system's AQI monitoring capabilities enable homeowners to monitor indoor air quality levels and take steps to improve air quality for a healthier living environment.

Emergency Response: Integration with emergency services allows for quick response in case of emergencies such as fires or medical incidents, potentially saving lives and reducing property damage.

Expandability and Customization: The system's modular design allows for easy expansion and customization, allowing users to add additional sensors or integrate with other smart home devices to suit their specific needs.

Smart Home Integration: The system can be integrated with other smart home devices and platforms, creating a comprehensive smart home ecosystem that enhances overall living comfort and convenience.

APPLICATIONS

- Residential Homes: Enhance security and convenience in individual houses or apartments by monitoring for fire, gas leaks, and intruders, and automating lighting and appliance control.

- Office Buildings: Improve security and energy efficiency in office buildings by monitoring for intruders and automating lighting, heating, and cooling systems based on occupancy.

- Retail Stores: Increase security in retail stores by monitoring for intruders and automating lighting and HVAC systems to create a comfortable shopping environment.

- Warehouses: Improve security and efficiency in warehouses by monitoring for intruders and automating lighting and climate control systems based on occupancy and environmental conditions.

- Schools and Universities: Enhance security in educational institutions by monitoring for intruders and automating lighting and HVAC systems to create a comfortable learning environment.

- Hospitals and Healthcare Facilities: Increase security in hospitals and healthcare facilities by monitoring for intruders and automating lighting and climate control systems to create a comfortable healing environment.

- Hotels: Improve security and guest experience in hotels by monitoring for intruders and automating lighting, HVAC, and guest room amenities based on occupancy and guest preferences.

- Smart Cities: Contribute to the development of smart cities by integrating with city-wide IoT networks to enhance security, energy efficiency, and overall quality of life for residents.

These are just a few examples of where your system can be used. Its flexibility and scalability make it suitable for a wide range of applications and environments.

FUTURE SCOPE

The future scope of your IoT-Based Home Security and Automation System is promising, with several avenues for further development and enhancement. Here are some potential areas for future expansion:

- Advanced Sensor Integration: Integrate additional sensors, such as smoke detectors, humidity sensors, and CO2 sensors, to further enhance safety and environmental monitoring capabilities.

- Machine Learning and AI: Implement machine learning algorithms to analyze sensor data and provide predictive analytics for better security and automation decision-making.

- Voice Control: Integrate voice control features using technologies like Amazon Alexa or Google Assistant for hands-free operation and enhanced user experience.

- Energy Harvesting: Implement energy harvesting techniques to power the system using ambient energy sources, reducing the reliance on batteries and increasing sustainability.

- Smart Grid Integration: Integrate with smart grid technologies to optimize energy consumption based on grid demand and pricing, further enhancing energy efficiency.

- Geofencing: Implement geofencing capabilities to automatically adjust home settings based on the user's location, improving convenience and energy savings.

- Security Camera Integration: Integrate security cameras for visual monitoring and recording, adding an extra layer of security and surveillance.

- Data Analytics and Visualization: Develop tools for analyzing and visualizing sensor data to provide insights into home security and energy usage patterns.

- Mobile Application: Develop a mobile application for remote monitoring and control, providing users with more flexibility and convenience in managing their smart home.

- Community Integration: Integrate with community-based IoT networks to enhance neighborhood security and share data for collective safety measures.

These future enhancements can further improve the functionality, efficiency, and user experience of your IoT-Based Home Security and Automation System, making it even more valuable for homeowners and businesses alike.

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