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# Advanced Home Automation and Security Systems Using IoT

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***Abstract*--The Home Automation System (HAS) is an expansion of the activities currently carried out inside the home. Thanks to today's powerful computing devices and wireless sensor networks (WSN), it is now possible to create an IoT-based smart bank that enables home automation with gesture detection and control. The main goal of this project is to create a home automation system utilizing an ESP32 board that can be remotely managed by any smartphone running the Android operating system. The traditional switches in modern homes are rapidly giving way to centralized control systems with remote-controlled switches. Have you ever imagined living in a world where you could just use your voice to tell your household equipment to operate as you require? In the near future, activated automated homes will be used. This project will show how to use the internet and your voice to manage household electronic items like TVs, fans, lights, and more on a tight budget. Today's Internet of Things (IOT) smart items are able to detect their own states and share them with other objects online, working together to make deft judgements on their own. Humans always look for alternatives around to do their work efficiently. Additionally, similar or alternative objects that are in line with user needs, the current situation, and prior knowledge should be able to be provided automatically by service provisioning in IOT. The rise of automated technologies has made life easier in every way. The preference today is for automatic systems over manual ones**.

## I. INTRODUCTION

A system for home automation and gas leak detection combines the automation of numerous household chores with the detection of gas leaks. By automating routine household functions like lighting and temperature management and offering a gas leak early warning system, the system is intended to simplify and protect its users' lives. Any type of gas, including propane, carbon monoxide, and natural gas, can be detected by the system. The system employs sensors to find the presence of a gas, and when it does, an alarm is set off to alert the home's residents. The alarm can be a silent text message alert or a loud audio alarm. The system also offers a central control panel that the user may utilise to manage a variety of house features, including lighting, temperature control, and locking and unlocking doors. Users will be able to operate the system using voice commands thanks to the system's ability to be integrated with voice control systems. The main goal of this project is to create a home automation system that can be remotely managed by any Android OS smartphone utilizing an Arduino board with Bluetooth. The traditional switches in modern homes are rapidly giving way to centralized control systems with remote-controlled switches. Have you ever imagined living in a world where you could just use your voice to instruct your household appliances to operate as you require? The days of needing to be a millionaire like Tony Stark in order to have an automated, voice-activated home are long gone. In this little video, I'm going to demonstrate how you can use your voice to manage a variety of electronic devices, including fans, TVs, lights, and the internet, on a budget. You don't need any prior programming or NodeMCU expertise to follow this guide. In order to understand about home automation, let's use Google Assistant and NodeMCU. Anything that makes it easier and more efficient for you to use your home's appliances, lighting, and heating is considered home automation. It might be as basic as controlling a few lights remotely or automatically, or it can be a full-fledged system that manages all the key appliances in your house. customised to suit your particular tastes. It focuses on wireless home automation technologies, which are simple to install into pre-existing homes without requiring new wiring or requiring the removal of carpets or wall-punching holes. Each technology has distinct advantages and features that make some more suitable for specific applications while others can be used for all standard installations of home automation. Providing automated control of electronic equipment in houses and other structures, as well as the detection of potential gas leaks, is the goal of the home automation and gas leakage detection system. The system's remote lighting, temperature, and ventilation controls, along with its ability to detect the presence of dangerous gases, are all designed to improve comfort, safety, and energy efficiency in the surrounding area.

## II. CHALLENGES

Sensor Accuracy: The gas leakage detection sensors used in home automation systems must be highly accurate in detecting the presence of gas. False positives or negatives can be dangerous, as they can lead to a failure to detect a gas leak or an unnecessary evacuation.

Communication and Integration: Home automation systems require integration with various devices and sensors, which can be challenging. Gas leakage detection sensors must communicate with the automation system quickly and reliably to trigger alarms and shut off gas supplies.

Power Supply: Gas leakage detection sensors need a reliable and continuous power supply to operate effectively. Battery-powered sensors may not be suitable for continuous monitoring, and their batteries must be regularly replaced to ensure they are functional.

Maintenance: Home automation systems with gas leakage detection require regular maintenance to ensure their continued reliability and accuracy. Regular calibration of gas sensors and testing of the entire system is necessary to ensure it is working correctly.

False Alarms: The home automation system's gas leakage detection sensors may occasionally trigger false alarms, which can lead to unnecessary evacuations. This can cause inconvenience to homeowners and lead to a lack of trust in the system's reliability.

System Complexity: Home automation systems with gas leakage detection can be complex, requiring expertise to install, maintain, and troubleshoot. This can add additional cost and effort to the homeowner.Overall, while home automation systems with gas leakage detection offer many benefits, they require careful consideration and planning to ensure they operate correctly and safely.

## III. RELATED WORKS

### *A. Optimization of sensor placement for structural health monitoring: areview*

The deployment cost of the structural health monitoring (SHM) system is the major argument against the more widespread use of the structural health monitoring techniques. Optimization of sensor placement offers an opportunity to reduce the cost of the SHM system without compromising on the quality of the monitoring approach. Several studies in the area of optimization of sensor placement for SHM applications have been undertaken but the approach has been rather application specific. This article is an attempt to present an unbiased state of the art of the work carried out in the area. The article is targeted towards researchers working in the field of structural health monitoring and optimization of sensor placement as well as practising engineers. This article reviews the work in the area of optimization of sensor placement. It first presents the definition of the optimization problem and then describes each step of the optimization. The currentstate of the art is then classified based on the techniques for which the optimization of sensor placement has beenoptimized.

### *B. Exclusive and ultrasensitive detection of formaldehyde at room temperature using a flexible and monolithic chemiresistive sensor*

Formaldehyde, a probable carcinogen, is a ubiquitous indoor pollutant, but its highly selective detection has been a long-standing challenge. Herein, a chemiresistive sensor that can detect ppb-level formaldehyde in an exclusive manner at room temperature is designed. The TiO2 sensor exhibits under UV illumination highly selective detection of formaldehyde and ethanol with negligible cross- responses to other indoor pollutants. The coating of a mixed matrix membrane (MMM) composed of zeolitic imidazole framework (ZIF-7) nanoparticles and polymers on TiO2 sensing films removed ethanol interference completely by molecular sieving, enabling an ultrahigh selectivity (response ratio > 50) and response (resistance ratio > 1,100) to 5 ppm formaldehyde at room temperature. Furthermore, a monolithic and flexible sensor is fabricated successfully using a TiO2 film sandwiched between a flexible polyethylene terephthalate substrate and MMM overlayer. Our work provides a strategy to achieve exclusive selectivity and high response to formaldehyde, demonstrating the promising potential of flexible gas sensors for indoor air monitoring. In this study, a monolithic flexible sensor that can detect ppb-level formaldehyde in a highly selective and sensitive manner at room temperature was designed. The key strategy of sensor design is the two-step screening of analyte gases: the highly selective photoactivation of sensing reactions only toward ethanol and formaldehyde at room temperature and physical filtering of ethanol using a molecular-sieving overlayer. For this, a highly photoactive TiO2 sensing film25 on a polyethylene terephthalate (PET) substrate was coated with a molecular-sieving ZIF-7/polyether block amide (PEBA) composite overlayer. PEBA with high flexibility, mechanical strength, and compatibility to ZIF-726 enables the coating of thin and homogeneous mixed matrix membrane (MMM) overlayer and offers the flexible sensor design. The TiO2 sensor with MMM overlayer exhibited an ultrahigh selectivity (57.4–6754.5 times) for formaldehyde overall indoor pollutants, including ethanol, and a high response (resistance ratio=2.4 toward 25 ppb formaldehyde) at 23℃ under UV light, whereas the pristine TiO2 sensor showed no discriminative gas responses

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### *C. Advances and new directions in gas-sensingdevices*

Gas sensors are employed in many applications including detection of toxic and combustible gases, monitoring emissions from vehicles and other combustion processes, breath analysis for medical diagnosis, and quality control in the chemicals, food and cosmetics industries. Many of these applications employ miniaturized solid-state devices, whose electrical properties change in response to the introduction of chemical analytes into the surrounding gas phase. Key challenges remain as to how to optimize sensor sensitivity, selectivity, speed of response and stability. The principles of operation of such devices vary and a brief review of operating principles based on potentiometric/amperometric, chemisorptive, redox, field effect and nanobalance approaches is presented. Due to simplicity of design and ability to stand up to harsh environments, metal oxide-based chemoresistive devices are commonly selected for these purposes and are therefore the focus of this review. While many studies have been published on the operation of such devices, an understanding of the underlying physicochemical principles behind their operation have trailed behind their technological development. In this article, a detailed review is provided which serves to update progress made along these lines. The introduction of Nano dimensioned materials has had a particularly striking impact on the field over the past decade. Advances in materials processing has enabled the fabrication of tailored structures and morphologies offering, at times, orders of magnitude improvements in sensitivity, while high-resolution analytical methods have enabled a much- improved examination of the structure and chemistry of these materials

## IV. PROPOSED METHODOLOGY

A system for home automation and gas leak detection can be created to monitor and manage different appliances and gadgets in a home as well as to find and notify the owner of any potential gas leaks. Here is an illustration of how the suggested system may function: Installed in the house, the system would be linked to a variety of equipment and gadgets, including lights, thermostats, and security cameras. Through a smartphone app, the homeowner could manage the devices and appliances.

### *A. Workflow of Home Automation*

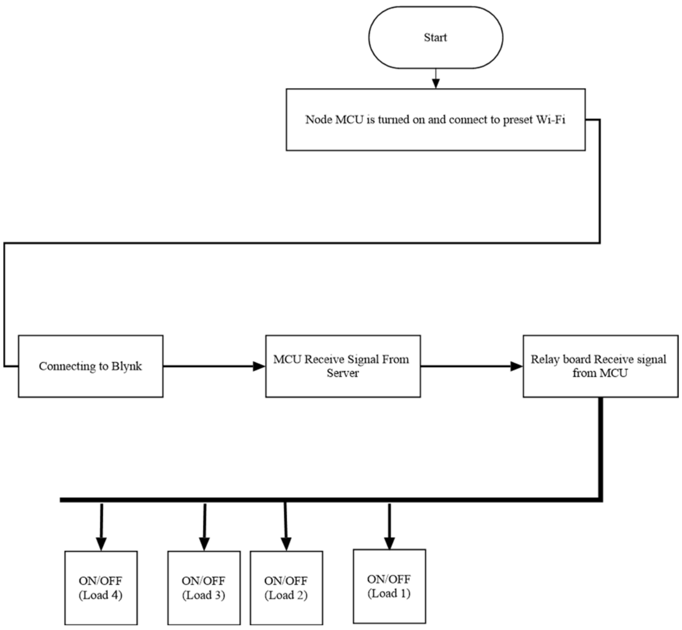


Fig 1: Workflow of Home Automation

### *B. Workflow of Gas Leakage Detection*

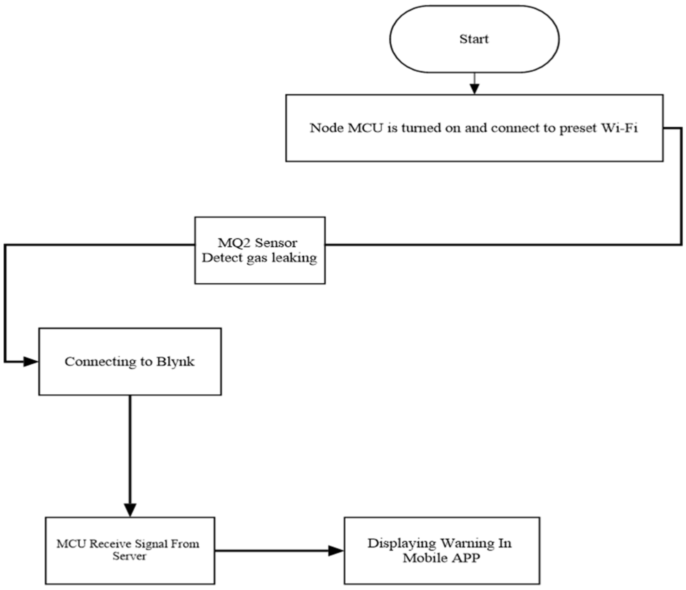


Fig 2: Workflow of Gas Leakage Detection

Sensors would be positioned all over the house to look for any gas leaks. The technology would promptly turn off the gas supply and alert the homeowner's smartphone if a gas leak was discovered. After that, the homeowner could take the necessary action, such leaving the house and calling the gas company. The device would also be able to offer real-time information on the gas levels in the house, enabling the owner to keep an eye on the situation and take appropriate action, such as calling the gas company and leaving the house. The system would also be able to deliver real-time information on the gas levels in the house, enabling the owner to keep an eye on things and adopt the necessary safety measures. The proposed system would, in general, boost the homeowner's convenience and safety by automating numerous duties and warning them of any potential concerns.

### *C. System Architecture*

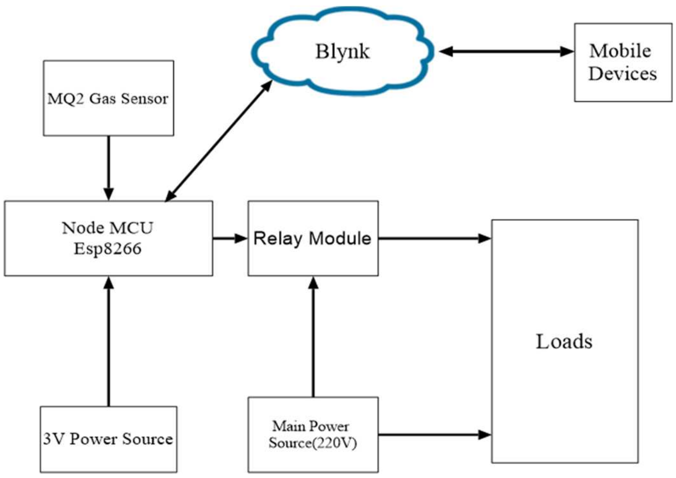


Fig 3: System Architecture

In this architecture, the sensors would be used to detect gas leaks and send the data to the control system. The control system would then process the data and initiate an appropriate response, such as triggering an alarm or controlling an actuator. The networking hardware would be used to connect the various components of the system to each other and to the internet, allowing the user interface to be accessed remotely. The user interface would provide a way for homeowners or other users to monitor the system and control the actuators.

### *D. Components*

- NodeMCU (ESP32)
- MQ-2 Gas Sensor
- 4-Channel Relay

**Blynk Cloud**: Blynk is a cloud-based platform that allows users to build Internet of Things (IoT) applications by connecting hardware devices to a mobile app. The platform includes a cloud service and an Android app that can be used to control and monitor the devices.The Blynk Android app is used to create a user interface for the IoT application. It allows users to control the devices and view sensor data from their mobile device. The app includes a variety of customizable widgets, such as buttons, sliders, and gauges, that can be used to control the devices and display sensor data.The Blynk cloud service is used to connect the hardware devices to the mobile app. It provides a secure and scalable infrastructure for connecting the devices and transferring data between them. The cloud service also includes a web-based dashboard that can be used to monitor and control the devices from a web browser.To use Blynk, you would need to install the Android app on your mobile device and set up a Blynk account.

### *E. Circuit Diagram*

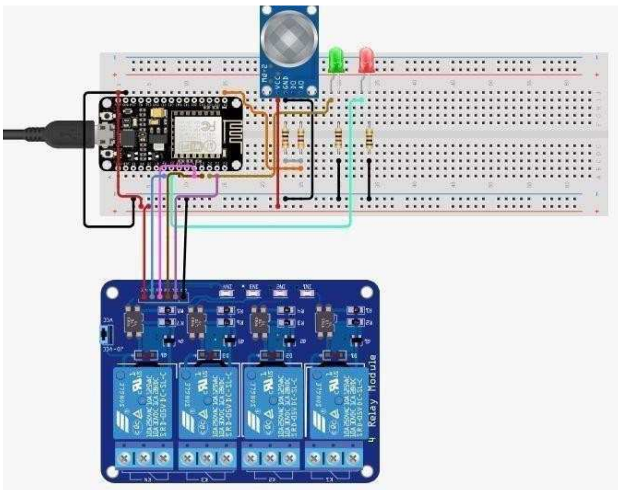

Fig 4: Circuit Diagram

## V. FUTURE SCOPE

Integration with AI and Machine Learning: With advancements in AI and machine learning, gas leakage detection sensors can learn and improve their accuracy over time. They can also identify patterns in gas leakage, which can help prevent gas leaks before they happen.
Smart Gas Detection: Smart gas detection systems can identify different types of gases and provide specific alerts. For instance, a smart gas detection system can differentiate between natural gas and carbon monoxide and provide relevant notifications.
Internet of Things (IoT) Integration: The integration of gas leakage detection sensors with IoT technology can provide better control and monitoring. Homeowners can access the system through their smartphones and receive real-time notifications and alerts.
Wireless Communication: Wireless communication can provide a more reliable and seamless communication between gas leakage detection sensors and the automation system. This can lead to faster detection and response times in case of a gas leak.
Automatic Shutoff Systems: Automatic shutoff systems can turn off the gas supply immediately in case of a gas leak, thereby preventing potential hazards. These systems can work in conjunction with gas leakage detection sensors to provide an added layer of safety.
Solar-powered Sensors: Solar-powered gas leakage detection sensors can provide an environmentally-friendly solution, reducing the reliance on batteries and ensuring continuous operation.

Overall, the future scope of home automation with gas leakage detection is exciting, and we can expect several advancements in the technology in the coming years. These developments can improve the reliability and safety of the system, making them an essential part of any smart home

## VI. CONCLUSION

Home automation with gas leakage detection is an important aspect of home safety and security. It offers homeowners a reliable and efficient way to detect gas leaks and prevent potential hazards. The integration of gas leakage detection sensors with home automation systems can provide real-time alerts, automatic shutoffs, and remote monitoring through smartphones and other devices.While there are challenges and limitations associated with home automation with gas leakage detection, including sensor accuracy, maintenance, and system complexity, the future scope of the technology is promising. Advancements in AI, machine learning, IoT integration, wireless communication, and automatic shutoff systems are expected to improve the technology's reliability and safety in the coming years.

Overall, home automation with gas leakage detection is a crucial investment for any homeowner concerned about their safety and security. By ensuring continuous monitoring and detection of gas leaks, this technology can prevent potential hazards and provide peace of mind to homeowners

## VII. ACKNOWLEDGEMENT

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