

IoT DRIVEN AUTONOMOUS HOUSE**Prof. Padmini K. Chandanbatwe**

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Abstract

The concept of smart homes has advanced significantly through the incorporation of the Internet of Things (IoT), edge computing, and artificial intelligence (AI). IoT-based autonomous houses leverage interconnected sensors, actuators, and smart devices to provide automated control of home environments, security, energy management, and user comfort. Providing a comprehensive overview of the state-of-the-art in IoT-driven home automation, this article investigates architectures, supporting technologies, protocols, and security challenges. It highlights future research directions and current trends, offering insights to support further advancements in residential automation. IoT-grounded independent home systems integrate detectors, selectors, microcontrollers, wireless communication networks, pall platforms, and artificial intelligence (AI) to enable automated monitoring, analysis, and control of ménage bias with minimum mortal intervention.

Keywords: AI, Autonomous Home, IOT, edge computing.

I. INTRODUCTION

An IoT-based autonomous house is a smart residential system that uses interconnected sensors, devices, and intelligent control mechanisms to automate and manage home operations with minimal human intervention. By integrating Internet of Things (IoT) technology with cloud computing, edge processing, and artificial intelligence (AI), these homes can monitor environmental conditions, detect occupancy, enhance security, and optimize energy consumption in real time. Unlike traditional home automation systems that require manual control, autonomous houses make intelligent decisions based on collected data and learned user behavior. For example, lighting systems adjust automatically according to occupancy, thermostats regulate temperature based on preferences, and security systems send instant alerts when unusual activity is detected. The growing demand for comfort, energy efficiency, security, and assistive living solutions has accelerated the development of IoT-based autonomous homes, making them a key component of modern smart living environments. The development of IoT-based autonomous houses is mainly driven by the need for energy efficiency, enhanced security, improved convenience, and support for aging populations. Energy efficiency is achieved through smart thermostats, automated lighting, and real-time energy monitoring systems that reduce unnecessary power consumption and lower electricity costs. Enhanced safety and security are provided by smart cameras, motion sensors, fire and gas detectors, and remote monitoring systems that offer real-time alerts and continuous surveillance. Convenience and quality of life are improved through

automation of daily tasks such as lighting, climate control, and appliance management, often controlled via smartphones or voice assistants. Additionally, autonomous houses support elderly and disabled individuals by incorporating features like fall detection, health monitoring, medication reminders, and emergency response systems, enabling safer and more independent living. Together, these factors make IoT-based autonomous homes an essential component of modern smart living.

II. ENHANCED HOME SAFETY AND SECURITY

Traditional security systems substantially give admonitions or introductory surveillance, whereas IoT-enabled independent homes offer intelligent, real-time monitoring and automated response mechanisms. These systems use connected detectors, smart bias, and artificial intelligence to descry, dissect, and respond to implicit pitfalls without taking constant mortal supervision. An IoT-grounded security system generally includes smart cameras with stir discovery, door and window detectors, smart cinches, bank sensors, gas leak detectors, and water leakage detectors. This bias continuously collect data about the home terrain. Advanced IoT security systems, enhanced by AI, provide superior protection by instantly detecting hazards—like intrusions or environmental dangers—and alerting homeowners via mobile apps. AI improves accuracy by differentiating residents from intruders, while enabling automated actions like locking doors. These smart, autonomous homes offer enhanced safety and remote, real-time surveillance of property and loved ones. Remote monitoring is another significant benefit. Homeowners can access live video streams, operate smart locks, and monitor sensor status from any location using mobile applications. This feature is particularly helpful for individuals who travel frequently or wish to keep an eye on children and elderly family members. Additionally, IoT-based safety systems go beyond intrusion detection by addressing environmental hazards through automated fire detection, carbon monoxide monitoring, flood detection, and electrical fault alerts.

III. PROBLEM STATEMENT

With the rapid-fire growth of urbanization and smart technologies, traditional homes still calculate heavily on homemade control of appliances, security systems, and energy operation. This frequently leads to hamstrung energy operation, lack of real-time monitoring, security vulnerabilities, and vexation for reside especially for senior or impaired individualities. numerous being smart home results bear constant stoner intervention or are limited to controlling individual bias, rather than furnishing a completely independent and intelligent terr that can dissect conditions and take conduct automatically. thus, there's a need to design and develop an IoT-driven independent house system that can cover environmental conditions, manage manages appliances, enhance security, and optimize energy consumption automatically using detectors, connectivity, and intelligent decision-timber. The proposed system aims to integrate IoT detectors, microcontrollers, cloud connectivity, and robotization algorithms to produce a home that can descry residency, acclimate lighting and temperature, examiner security pitfalls, and control bias without primer intervention, thereby perfecting comfort, safety, and energy effectiveness.

IV. RELATED WORK

Wei-Chung Teng et al. provide an overview of various remote sensors used for home monitoring, particularly for the care of the elderly. The monitoring system is established through the integration of multiple sensors and is capable of transmitting data via wireless communication. The main processor gathers and stores data for both immediate use and future reference. This technology captures an individual's lifestyle. Gowthami.T1 and focus on the ability to control and monitor a smart home from a distance, ensuring security when the homeowner is away. A personal computer is utilized to track various parameters in the proposed system. In this approach, an Android phone is used for the control and monitoring process. Android phones offer a significant advantage over traditional computers because they can be used anywhere. To monitor and control various parameters remotely, ZigBee technology is utilized, which has been tested in laboratory environments and can also be integrated with Android phones. Patru et al. presented an approach for connecting multiple devices through a signal-based system that allows easy and flexible access at any time. Their system combines the functionalities of different home automation devices into a single application. The authors explain the development of a smart home system that integrates intelligent appliances such as the Philips Hue light bulb and the Nest Thermostat, along with various sensors, detectors, buzzers, and motors. This system can be controlled through a mobile device using an internet connection. Ravi Kishore Kodali et al. describe the design and implementation of a wireless home control and access system that allows entry only to authorized individuals. The proposed system is based on a ZigBee wireless network and uses a PCA-based image processing technique to enhance security. ZigBee modules and an electromagnetic door lock work together to control door access. Face detection and recognition techniques

are employed to identify visitors, and the system automatically sends email notifications and alert messages about the home’s status to the homeowner via a GSM network.

V.EXISTING METHODOLOGY

A home robotization and security system is designed to control manage appliances while also notifying the homeowner about intrusions or fire incidents. The system incorporates stir discovery and meddler discovery using detector circuits, along with factors similar as LDR (Light Dependent Resistor) and RF modules. still, stir detectors may not serve directly under all environmental conditions. thus, it's necessary to develop a smart home security system that uses effective detectors while remaining cost - effective An Arduino-grounded home robotization and security system operates in such a way that when a person enters the house, the total number of inhabitants is automatically incremented. contemporaneously, the light turns on and an alarm may sound. The total number of people present inside the room is displayed on an TV screen. When the room becomes empty the light automatically turns off, thereby perfecting energy efficiency. In addition, a GSM- and Android- grounded home security system sends an SMS announcement to the homeowner whenever an unauthorized person attempts to enter the house. This communication cautions the proprietor about possible meddler presence, allowing them to take applicable security measures. likewise, home appliances can be controlled through an Android mobile operation, reducing homemade trouble and enhancing convenience

VI.BLOCK DIAGRAM

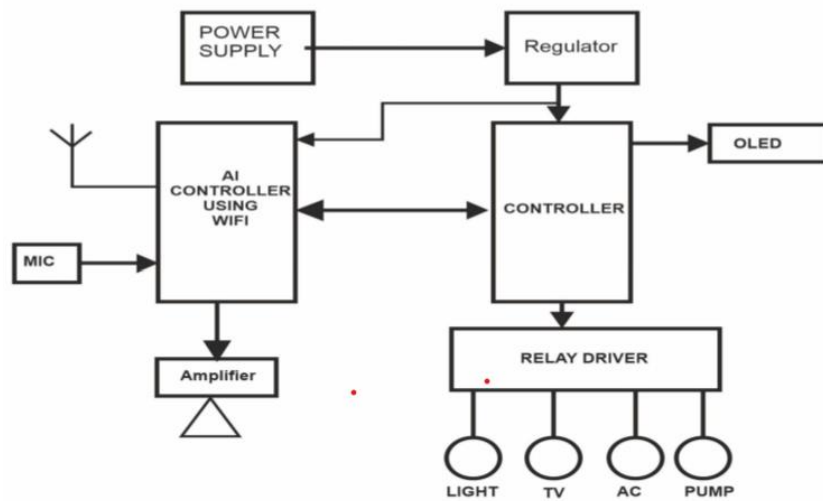


Fig.1: Block diagram

VII. COMPONENTS

1.ESP 32 S3:

ESP32- S3 provides all the demanded security conditions for securely connected bias, without taking external factors. It supports AES- XTS- grounded flash encryption, RSA- grounded secure charge, digital hand and HMAC. ESP32- S3 also has a “World Controller” which provides two completely- insulated prosecution surroundings, which enables the perpetration of a trusted- prosecution terrain or honour - separation scheme. It also supports large external memory like (Flash/ PSRAM) and offers smooth connectivity with support for 2 Mbps PHY and Enciphered PHY for long range, all controllable through standard ESP- IDF or Platform IO.



Fig.ESP 32 S3

2.SPDT RELAY:

A Single Pole Double Throw (SPDT) relay is an electromechanical switch that connects one input terminal to one of two possible output terminals. It has five terminals in total: two terminals for the coil and three terminals for switching—Common (COM), Normally Open (NO), and Normally Closed (NC). When the coil is not supplied with power, the common terminal remains connected to the normally closed contact. Once voltage is applied to the coil, an electromagnetic field is produced, which moves the internal armature and shifts the connection from the normally closed contact to the normally open contact. This allows a low-voltage signal to control devices operating at higher voltages or currents while maintaining electrical isolation between the control and load circuits. SPDT relays are typically manufactured with coil ratings such as 5V, 12V, or 24V, and they can handle switching capacities up to 250V AC or 30V DC, depending on their specifications. These relays are widely used in applications including home automation, IoT systems, industrial equipment, automotive electronics, and robotics. In smart home setups, microcontrollers like Arduino or ESP8266 can trigger an SPDT relay to control appliances such as lights, fans, or water pumps. Although SPDT relays are cost-effective and dependable, their mechanical components can wear out over time, and they operate more slowly compared to solid-state relays. Nevertheless, due to their ease of use, flexibility, and effective isolation capability, SPDT relays remain an important component in many electrical and electronic applications.

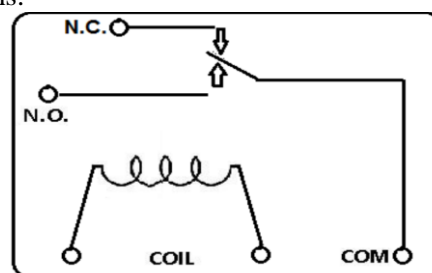


Fig. SPDT relay

VIII.APPLICATIONS

1. Smart Lighting

Smart lighting is a crucial element of an IoT- driven independent house. It refers to lighting systems that can automatically acclimate brilliance, color, and on/ off status grounded on environmental conditions, stoner preferences, or detector data. Unlike traditional lighting, smart lighting uses internet- connected bias, detectors, and regulators to automate lighting operations without constant homemade control. Smart lighting improves energy effectiveness, comfort, and convenience by intelligently controlling lights depending on residency, daylight situations, and schedules.

2. Energy Management

Energy Management in an IoT- driven independent house refers to the monitoring, controlling, and optimizing of energy consumption using connected bias and intelligent systems. The main thing is to reduce electricity operation, lower energy costs, and ameliorate effectiveness without affecting the comfort of resider. Traditional homes frequently waste energy because appliances are left running unnecessarily. IoT technology allows homes to automatically cover energy operation and make smart pinions similar as turning off unused bias, conforming heating or cooling systems, and optimizing lighting.

3. Home Security

a software system designed to help homeowners cover, control, and cover their houses from implicit pitfall similar as theft, intrusion, fire, or other extremities. These operations are generally connected to smart security bias like cameras, stir detectors, door and window detectors, and smart cinches. Through a mobile or web interface, druggies can cover live videotape feeds, admit instant cautions when unusual exertion is detected, and ever control security bias from anywhere. numerous ultramodern home security operations also integrate with Internet of effects (IoT) technology, enabling robotization features similar as automatically locking doors, turning on lights when stir is detected, or cranking admonitions if unauthorized access occurs. In addition, the operation may store recorded footage in pall storehouse, allowing druggies to review once events and give substantiation if demanded. Some systems also include facial recognition, voice control through smart sidekicks, and exigency contact features that notify authorities or family members during critical situations. Overall, a home security operation improves safety,

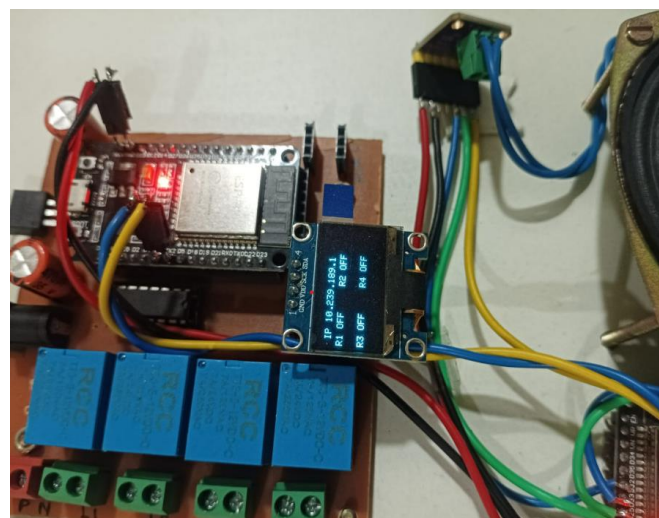
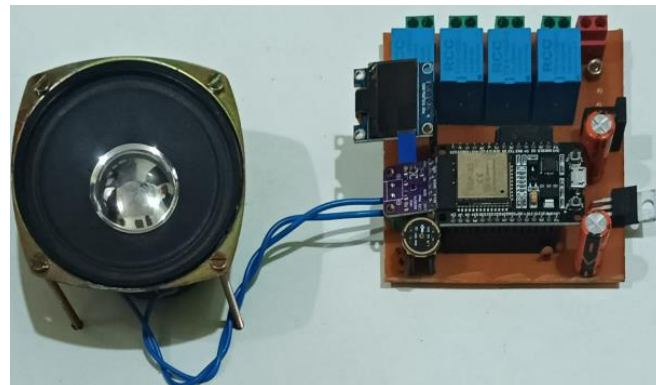
provides real-time monitoring, and offers convenience by allowing homeowners to manage and secure their property using smartphones or computers.

VII.COMPARATIVE RESULT ANALYSIS

A comparative analysis of AI voice assistants evaluates their performance based on key parameters like accuracy, response time, language support, naturalness of speech, and user satisfaction. Below is an example comparison of popular AI Voice Assistants:

Parameter	Siri (Apple)	Google Assistant	Alexa (Amazon)	Cortana (Microsoft)
Speech Recognition Accuracy	92%	95%	90%	88%
Response Time	1.2 Sec	1.0 Sec	1.5 Sec	1.4 Sec
Number of Supported Languages	21	30	10	8
Smart Home Integration	Moderate	High	Very High	Low
Contextual Understanding	Medium	High	Medium	Low
User Satisfaction	4.2/5	4.5/5	4.1/5	3.8/5

VIII.RESULT



IX.CHALLENGES AND LIMITATIONS

Despite its advantages, home robotization systems face several challenges. Security and sequestration are major enterprises because smart bias connected to the internet may be vulnerable to hacking. comity between different bias from different manufacturers can also produce difficulties in system integration.

Another limitation is the original cost of installation, which can be high for some druggies. Network trustability is also important because robotization systems depend heavily on internet connectivity.

VIII. FUTURE SCOPE

The unborn prospects of IoT- grounded independent home systems are expanding fleetly as a result of nonstop developments in communication technologies, artificial intelligence, and bedded systems. With the growing global relinquishment of smart homes, multitudinous exploration openings live to ameliorate system performance, intelligence, security, and sustainability. A crucial area of advancement is the objectification of sophisticated Artificial Intelligence (AI) and Machine literacy (ML) ways to achieve completely automated decision- timber. Upcoming smart homes will be able of assaying stoner soothsaying energy consumption, and automatically conforming lighting, temperature, and appliances without mortal involvement. also, deep literacy approaches for exertion monitoring and anomaly discovery will enhance both customization and overall system security.

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