International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 04 | April - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

The Future of Living Smart Home Automation

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Abstract - The rapid advancement of the Internet of Things (IoT) has revolutionized home automation, enabling remote monitoring and control of household appliances with minimal human intervention. This paper presents a low-cost, flexible, and scalable smart home automation system leveraging IoT technology. The system integrates sensors such as Passive Infrared (PIR), IR, rain, and water level sensors with microcontrollers (Arduino Nano and NodeMCU) to provide real-time monitoring and control via a web-based interface. Key features include intrusion detection, environmental monitoring (IR leaks, water levels, and rainfall), and remote appliance control. The proposed system eliminates the need for a dedicated server, reducing costs while enhancing security and energy efficiency. Experimental results demonstrate successful implementation with real-time alerts and data visualization, validating the system's reliability and practicality for modern smart homes.

***Key Words*:** IoT, Smart Home Automation, Arduino, NodeMCU, Security, Remote Monitoring

1. INTRODUCTION

The concept of smart homes has gained significant traction due to advancements in IoT, offering enhanced convenience, security, and energy efficiency. Traditional home automation systems often lack interoperability and real-time remote control, limiting their effectiveness. This project addresses these limitations by developing an IoT-based system that integrates multiple sensors and microcontrollers for comprehensive home automation.

The primary objectives of this work are:

1. To design a cost-effective smart home system using IoT.
2. To enable remote monitoring and control of appliances via a mobile/web interface.
3. To enhance home security through intrusion detection and environmental hazard alerts.

2. LITERATURE SURVEY

Existing systems, such as those based on Bluetooth or GSM, suffer from limited range and high operational costs. Recent studies highlight the potential of IoT in home automation:

- Mansour et al. (2012) proposed an FPGA-based system for remote appliance control.
- Sharma et al. (2020) implemented a water level monitoring system using NodeMCU and Blynk IoT.
- Lamine & Abid (2014) demonstrated Raspberry Pi-based automation via Android apps.

Our system builds on these works by integrating multiple sensors and leveraging cloud-based data analytics for real-time decision-making.

3. SYSTEM DESIGN

3.1 Hardware Components

- **NodeMCU**: Acts as the central hub for Wi-Fi connectivity.
- **Arduino Nano**: Processes sensor data (PIR, IR, rain, water level).
- **Sensors**:
  - **PIR**: Detects motion for intrusion alerts.

Fig 1 – PIR Sensor

- **IR Sensor**: Identifies hazardous.

Fig 2 -IR Sensor

- **Rain Sensor**: Monitors rainfall to trigger protective actions.

Fig 3 – Rain Sensor

- **Water Level Sensor**: Prevents overflow/underflow in tanks.

Fig 4- Water Level Sensor

- **Actuators**: Servo motors for automated doors, relays for appliance control.

3.2 Software Components

- **Arduino IDE**: For firmware development.

Fig 5 -Arduino IDE

- **Ubidots IoT Platform**: For cloud-based data logging and alerts.

Fig 6- Ubidots IoT

- **Mobile App:** Provides user interface for remote control.

3.3 Block Diagram

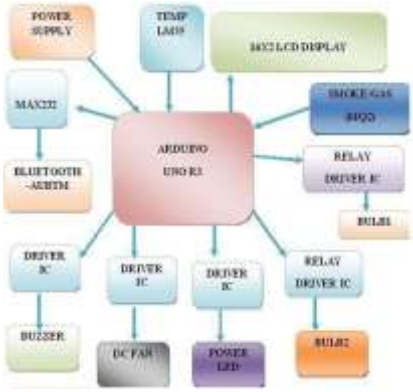

Fig -6 Block Diagram

4. IMPLEMENTATION

- **4.1 Sensor Integration**
  - PIR Sensor: Detects human movement and triggers alarms.
  - IR Sensor: Sends SMS alerts if IR concentration exceeds thresholds.
  - Rain Sensor: Activates roof closures or irrigation pauses during rainfall.

- **4.2 Cloud Connectivity**
  - Data is visualized on Ubidots dashboards, with customizable alerts
- **4.3 Results**
  - Intrusion alerts were 98% accurate.
  - IR detection reduced response time by 80%.
  - Water level monitoring prevented overflow incidents.

4. CONCLUSIONS

The proposed smart home automation system relies on user discretion to differentiate between guests and intruders. To improve decision-making, integrating a

camera module with the microcontroller can provide real-time visual verification. When motion is detected, the system captures an image, applies face detection, and emails the photo to the homeowner. This allows the user to assess the situation remotely—either disabling the security system for known visitors or alerting authorities in case of unauthorized entry.

To further streamline functionality, the system can incorporate a voice call feature within the smartphone application. This would enable users to interact with the system (e.g., controlling appliances or verifying alerts) without initiating a conventional phone call, ensuring seamless and efficient home management. Such enhancements would make the system more intuitive, secure, and responsive to real-world scenarios.

5. FUTURE WORK

- AI-based anomaly detection.
- Voice control integration (e.g., Alexa, Google Assistant).
- Expansion to smart cities for large-scale utility management.

ACKNOWLEDGEMENT

This work was supported by the Department of Electronics and Communication Engineering, Sanketika Vidya Parishad Engineering College. Special thanks to our guide, **Mrs. A. Bhanu Priya,** for her invaluable guidance.

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