Literature Survey

The rapid growth of the Internet of Things (IoT) has transformed how residential environments are managed, monitored, and controlled. Smart home systems today aim to improve energy efficiency, enhance user convenience, and ensure safety through intelligent automation. Several studies have contributed to this evolving field, each addressing different facets of IoT-based home automation.

The paper *"Design and Implementation of an IoT-Based Energy Consumption Monitoring System in Smart Homes"* presents a foundational approach to monitoring electrical power consumption using IoT technology. The authors implemented an ESP32 microcontroller connected to current sensors to collect and transmit real-time power usage data to a cloud platform. This data was visualized on a dashboard for user analysis, enabling insights into consumption trends and power optimization. While effective in tracking and displaying energy data, the study was limited to monitoring alone, without incorporating automated control or intelligent decision-making for energy management.

The study *"Electrical Load Control Using PIR Sensor for IoT-Based Electrical Power Saving"* builds upon energy monitoring by integrating occupancy-based automation. Using multiple Passive Infrared (PIR) sensors, the system detects human presence and automatically controls electrical loads such as lights and fans. This not only reduces wastage but also ensures that appliances operate only when needed. The research demonstrated tangible reductions in energy consumption and provided evidence of the efficiency gains possible when IoT systems are combined with real-time sensor inputs and automated control mechanisms. However, it primarily focuses on load control without integrating additional features such as environmental monitoring or advanced security.

The paper *"IoT-Based Smart Home Automation Systems: Enhancing Energy Efficiency and Security"* advances the concept further by combining both automation and security functions. The system employs PIR sensors and surveillance cameras to detect motion and intrusions, while also optimizing energy usage through selective appliance control. Remote monitoring and control are achieved via IoT-based dashboards, allowing users to supervise their homes from anywhere. The research highlights the growing importance of multi-functional IoT systems that address both comfort and safety.

Collectively, these works lay the groundwork for the **HomeGridX** system. While prior studies have concentrated on specific domains such as power monitoring, motion-based control, or security, HomeGridX aims to integrate all three within a unified IoT ecosystem. The proposed system utilizes the ESP32 microcontroller, Firebase Realtime Database, and DHT22 sensors to create an efficient, scalable, and intelligent smart home solution. By monitoring environmental

parameters, detecting motion, and tracking real-time power usage, HomeGridX not only automates appliance control but also enhances energy conservation and home safety.