SIMULATION OF SMART HOME AUTOMATION SYSTEM USING AUTODESK TINKERCAD

Hariraja S[1], Sachin R[2], Shiyam Prasatth V[3], Balaji P[4], Elango K[5],
[1234]Students, [5]Professor and Head of Department (EEE),
SRM Valliammai Engineering College, Chennai.
hariraja1822@gmail.com , hod.eee@srmvalliammai.ac.in .

.

Fig.no:1 Home automation system

I. ABSTRACT

The Simulation Project "Smart Home Automation System Using Tinker Cad Simulation" aims to design and implement a technologically advanced home environment that simplifies daily routines, enhances energy efficiency, and fortifies security measures. This project leverages Tinker cad, a versatile cloud-based simulation tool, to create and test an interconnected system of IoT devices, including sensors, actuators, and Arduino microcontrollers. It explores key functionalities such as automated lighting systems that adjust based on occupancy and ambient light levels automatic door opening system, gas detection and alarm system and features incorporating motion detection switching of home devices.

KEYWORDS: Smart Home Automation, Home Automation System, Simulation, Autodesk Tinker cad, IoT Simulation, Embedded Systems Simulation, Wireless Sensor Networks (WSN), Microcontroller Simulation

II. INTRODUCTION

The integration of the Internet of Things (IoT) into our daily lives has redefined modern living, offering innovative solutions to enhance convenience, safety, and energy efficiency. Among the various applications of IoT, smart home automation systems stand out as one of the most impactful and rapidly evolving technologies. These systems enable seamless interaction between users and their home environments through smart devices, sensors, and microcontrollers, bringing the dream of a fully connected and intelligent home closer to reality.

In the realm of smart home automation, Tinker cad emerges as a powerful platform for simulation and design. As a cloud-based tool, Tinker cad provides a virtual environment to prototype, simulate, and test the functionality of IoT-enabled circuits and systems without the need for physical hardware. This makes it an ideal choice for both beginners and professionals to experiment with automation concepts in a cost-effective and risk-free manner. By utilizing Tinker cad, this project seeks to design a smart home system that integrates various components, such as motion sensors for security, light-dependent resistors for automated lighting, and temperature sensors for climate control.

The system's core functionalities include automated lighting that responds to occupancy and ambient light levels, intelligent temperature regulation based on real-time data, and enhanced security measures featuring motion detectors and alarms. These features can be controlled and monitored through user-friendly interfaces, such as mobile apps or voice commands, ensuring ease of use and accessibility. Additionally, the project highlights the potential of IoT in promoting energy efficiency by optimizing resource usage, thus contributing to a more sustainable lifestyle.

III. METHODOLOGY

1. Identifying Objectives

- Define the goals of the smart home automation system (e.g., energy efficiency, convenience, security).
- Specify the features to be integrated (e.g., lighting control, temperature regulation, home security).

2. Requirements Analysis

- Collect and analyse user requirements for the system.
- Determine hardware and software needs, such as sensors, microcontrollers, communication protocols (e.g., Wi-Fi, Zigbee), and mobile/web applications.

3. System Design

- Hardware Design: Decide on the placement and selection of devices like sensors, actuators, controllers, and hubs.
- Software Design: Develop algorithms and software for device control, data processing, and user interface.
- Network Design: Plan the communication architecture (e.g., centralized or distributed).

IV. BLOCK DIAGRAM

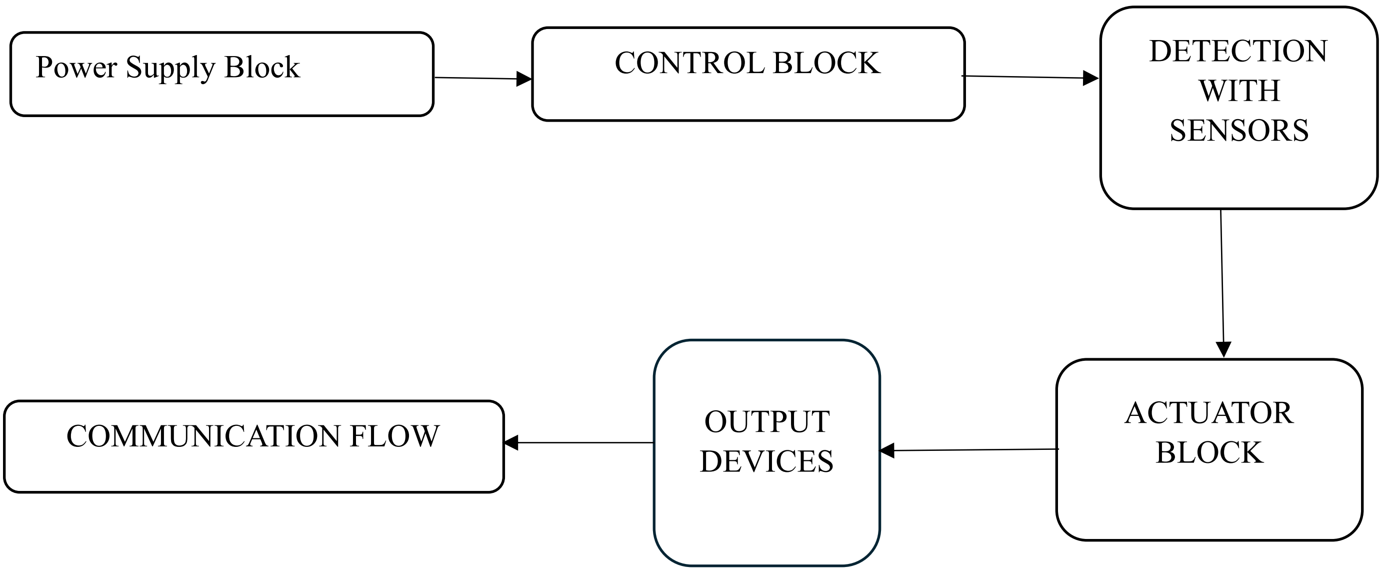


Fig.no:2 Block Diagram

V. CIRCUIT DIAGRAM

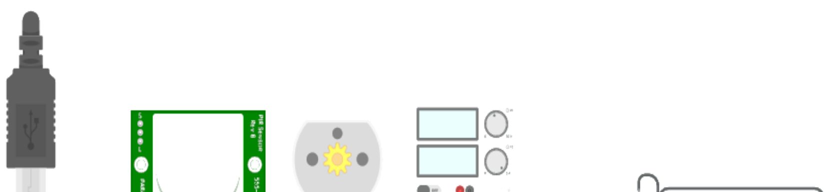


Fig.no:3 Circuit Diagram of home automation system.

VI. WORKING

Elaborate Working Scenario:

Imagine a scenario where this system is used for automated lighting and security:

1. Motion Detection: If someone enters a room, the PIR sensor detects their movement and sends a HIGH signal to the Arduino.

2. Light Level Check: Simultaneously or based on the motion detection, the Arduino reads the value from the LDR. If the ambient light level is low (high resistance of LDR, low voltage at the analog pin), the Arduino proceeds to the next step.

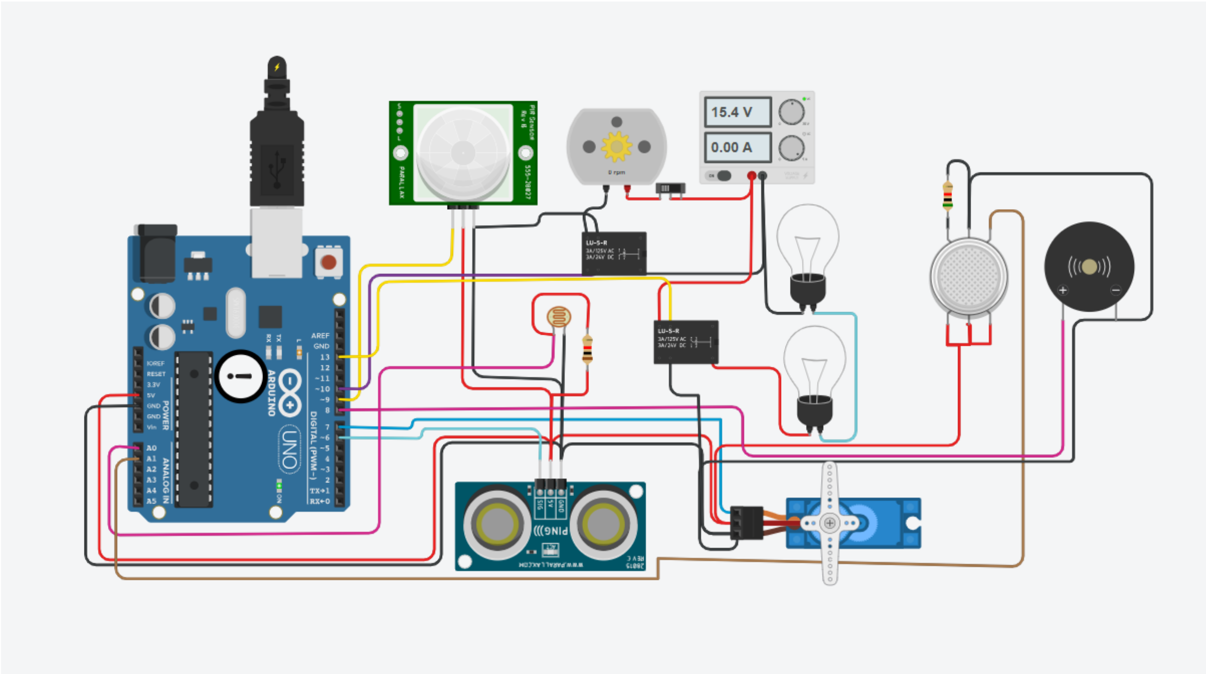
3. Turning on Lights: The Arduino then sends a control signal to the relays connected to the light bulbs, activating them and turning on the lights.

4. Distance Monitoring: The ultrasonic sensor could be used to detect if someone is approaching a specific area. If the distance is below a certain threshold, the Arduino could trigger other actions.

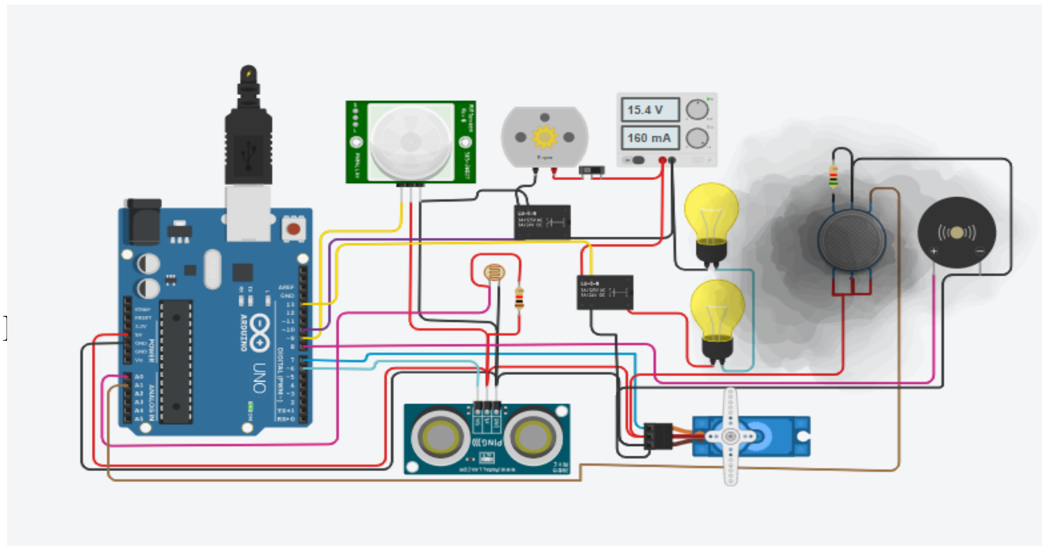
5. Security Alarm: If motion is detected by the PIR sensor during specific hours (e.g., nighttime) and the light level is low, the Arduino could activate the buzzer as an alarm.

6. Servo Control (Optional): The servo motor could be used to control a door lock. For example, upon motion detection and a specific condition being met, the Arduino could send a signal to the servo to unlock the door.

VII.SIMULATION PROCESS



DETECTION GAS BY GAS SESOR:

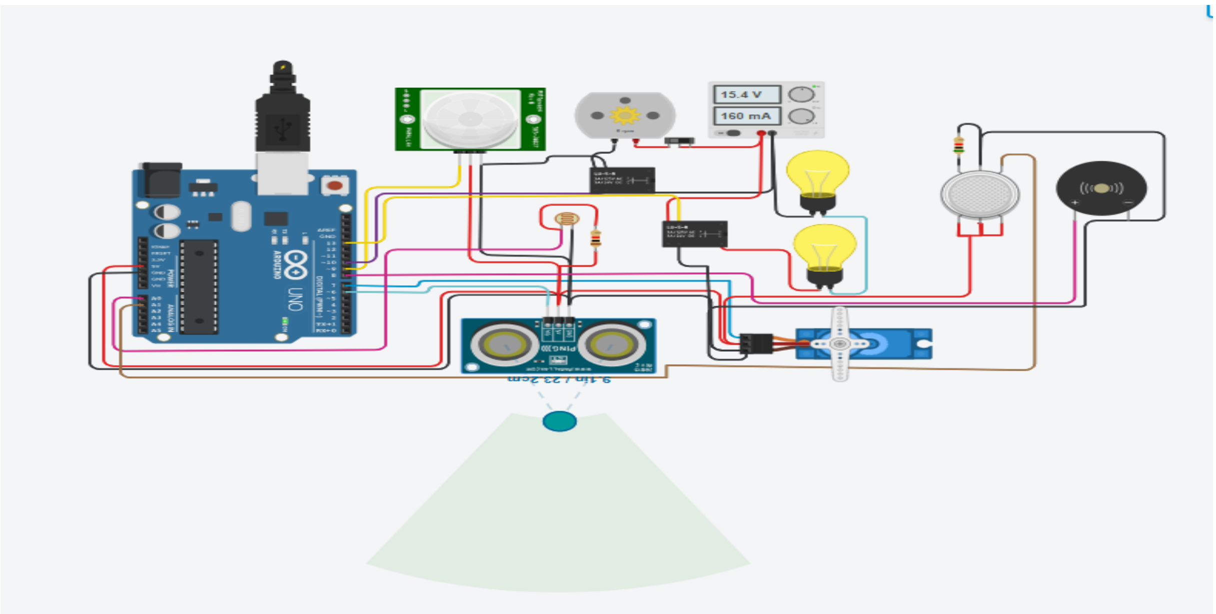


I ISTOR:

Fig.no:5 Working of Photoresistor

DETECTION OF MOTION BY ULTRASONIC DISTANCE SENSOR:

Fig.no.6 working of Ultrasonic Distance Sensor



DETECTION OF MOTION BY PIR SENSOR FOR CONTROL OF FAN:

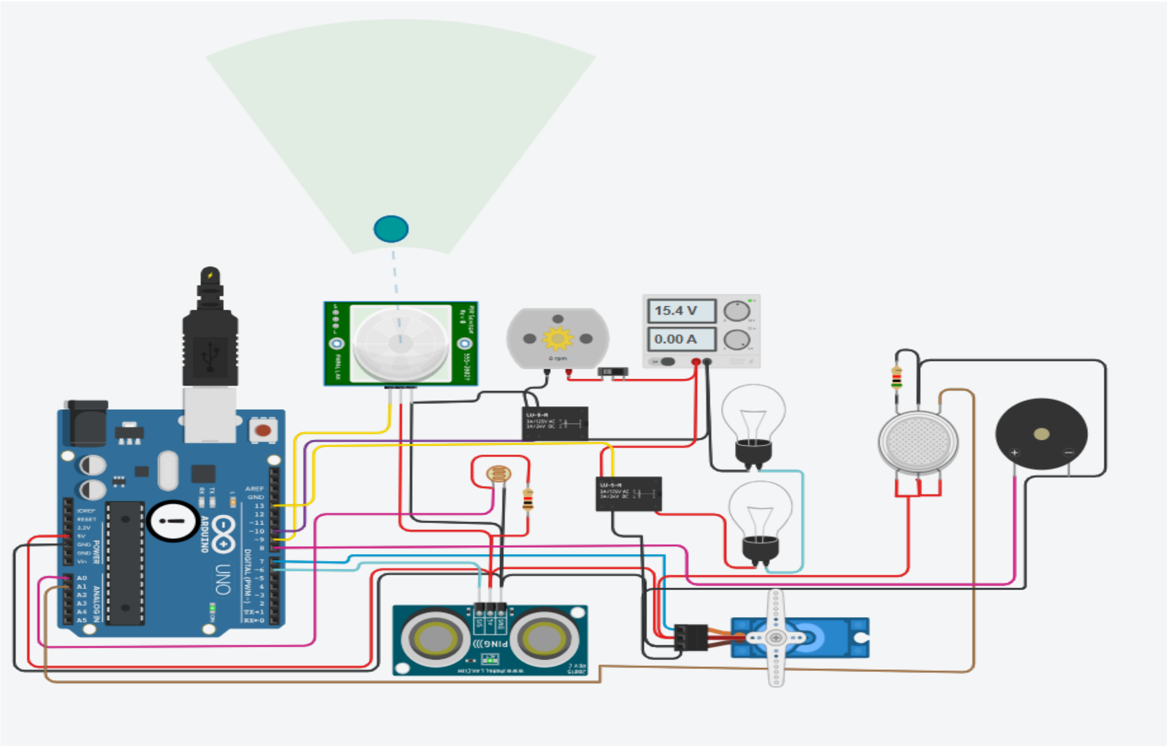


Fig.no.7 Working of PIR Sensor

VII. FUTURE DEVELOPMENT

The future scope of a Smart Home Automation System is vast, with advancements in technology opening new possibilities. The integration of artificial intelligence (AI) and machine learning (ML) can enable the system to learn user preferences and adapt dynamically, providing personalized experiences. The use of blockchain technology may enhance security, ensuring safe communication and data sharing among devices. Expanding compatibility with emerging Internet of Things (IoT) devices can broaden the range of automation options. Additionally, incorporating renewable energy solutions, such as solar-powered smart devices, can make the system more environmentally sustainable. The development of voice and gesture recognition technology may further improve accessibility for users, including those with disabilities. Future innovations could also focus on enhancing system interoperability, allowing different brands and platforms to work seamlessly together. Overall, the smart home automation system has the potential to revolutionize daily living, making homes smarter, safer, and more energy efficient.

IX. RESULT AND DICUSSION

The Smart Home Automation System project yielded valuable insights into its performance, efficiency, and usability. The system demonstrated high functionality, successfully executing most user commands with minimal errors, and showcased scalability by supporting numerous connected devices without compromising stability. Network performance testing revealed low data latency under normal conditions, while energy consumption analysis highlighted significant improvements in efficiency. Security testing uncovered minor vulnerabilities, which were addressed to ensure robust protection against threats. User interaction feedback indicated a positive experience, with participants finding the system intuitive and easy to use. Environmental stress testing validated the system's resilience in varying conditions. Overall, the system met key objectives, offering a reliable, efficient, and user-friendly solution for smart home automation, with recommendations for enhancing security and expanding device integration to improve its versatility further.

X. CONCLUSION

In conclusion, this smart home automation simulation project using Autodesk Tinker cad has not only provided a practical understanding of the underlying principles but has also illuminated the transformative potential of intelligent living. It has demonstrated the feasibility of creating a responsive and automated home environment through the synergistic interaction of sensors, microcontrollers, and actuators. This virtual exploration serves as a stepping stone towards understanding the real-world implementation and the profound impact that smart home automation can have on our daily lives, paving the way for more comfortable, secure, and sustainable living spaces. The accessibility of Tinker cad makes such explorations invaluable for education and for fostering innovation in the rapidly evolving field of smart home technology.

REFERENCES

1. D. -I. Gota, A. Puscasiu, A. Fanca, L. Miclea and H. Valean, "Smart home automation system using Arduino microcontrollers," *2020 IEEE International Conference on Automation, Quality and Testing, Robotics (AQTR)*, Cluj-Napoca, Romania, 2020, pp. 1-7, doi: 10.1109/AQTR49680.2020.9129989.

2. Mamta, A. Paul and R. Tiwari, "Smart Home Automation System Based on IoT using Chip Microcontroller," *2022 9th International Conference on Computing for Sustainable Global Development (INDIACom)*, New Delhi, India, 2022, pp. 564-568, doi: 10.23919/INDIACom54597.2022.9763287.

3. V. Tsankov, B. Evstatiev and I. Valova, "Concept for an IoT-based Electronic System for Smart Home Automation," *2024 9th International Conference on Energy Efficiency and Agricultural Engineering (EE&AE)*, Ruse, Bulgaria, 2024, pp. 1-5, doi: 10.1109/EEAE60309.2024.10600500.

4. S. Niranjana, R. S. Lavanya, S. Sangeethapriya, N. Nagaraju, B. V. Prasanth and C. Karthikeyan, "Experimental Procedure to Develop an IoT Based Smart Home Automation System Using Intelligent Sensors Association," *2024 International Conference on Innovative Computing, Intelligent Communication and Smart Electrical*

Systems (ICSES), Chennai, India, 2024, pp. 1-6, doi: 10.1109/ICSES63760.2024.10910781.

5. M. Kumar, R. K. Gupta, G. Jain and P. sharma, "Next-Generation Smart Homes: An IoT Approach to Home Automation and User Experience," *2024 International Conference on Artificial Intelligence and Quantum Computation-Based Sensor Application (ICAIQSA)*, Nagpur, India, 2024, pp. 1-6, doi: 10.1109/ICAIQSA64000.2024.10882400.

6. M. R. Habib *et al.*, "A Comprehensive Review on the Advancement of Home Automation System," *2024 Second International Conference on Intelligent Cyber Physical Systems and Internet of Things (ICoICI)*, Coimbatore, India, 2024, pp. 638-642, doi: 10.1109/ICoICI62503.2024.10696135.

7. N. Solangi, A. Khan, M. F. Qureshi, N. Zaki, U. M. Qureshi and Z. Umair, "IoT Based Home Automation System: Security Challenges and Solutions," *2024 5th International Conference on Advancements in Computational Sciences (ICACS)*, Lahore, Pakistan, 2024, pp. 1-6, doi: 10.1109/ICACS60934.2024.10473277.